NURSE PRACTITIONER PATIENT CARE PATTERNS AND PRACTICE CHARACTERISTICS: UNDERSTANDING THE ROLE OF STATE SCOPE-OF-PRACTICE POLICIES

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DEDICATION

First, I dedicate this dissertation to my husband, Corey Anderson. This body of work would not have been possible without his unwavering support and countless sacrifices. I must also acknowledge our dogs Gizmo and Waldo for accompanying me on long walks while I thought through some of the more challenging analyses and sections of this research.

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Third, I dedicate this dissertation to the all the American men, women, and children who struggle with access to high quality and affordable health care. I can only hope that this work promotes additional health policy research and that future research may lead to meaningful policy reform that improves access to high quality and affordable health care for all Americans.

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Connor W. Norwood

NURSE PRACTITIONER PATIENT CARE PATTERNS AND PRACTICE CHARACTERISTICS: UNDERSTANDING THE ROLE OF STATE SCOPE-OF-PRACTICE POLICIES

Introduction: The U.S. is faced with a primary care (PC) workforce shortage; an estimated 43 percent of the population has unmet health care needs and 18.2 percent of the adult population lacks a usual source of care (USC) provider. The workforce shortage limits even those with a USC from receiving the full scope of recommended clinical services. One promising solution is reforming scope-of-practice (SOP) policies for PC nurse practitioners (NPs).

Objectives: The primary objective of this dissertation was to assess the impact of NP SOP policy implementation on NP practice patterns and patient access to PC by evaluating NP time spent delivering patient care, NP role as USC providers, patient travel times, and appointment availability.

Methods: The studies discussed in this dissertation leveraged cross-sectional data from the National Sample Survey of Nurse Practitioners (NSSNP), time-series data from the Medical Expenditure Panel Survey (MEPS), and the Nurse Practitioner Professional Practice Index (NPPPI) to quantify variations in state policy environments. We used generalized mixed effects models to examine relationships in the cross-sectional data analyses and two-way fixed effect models to evaluate longitudinal data.

Results: Our analyses revealed several key findings: NP SOP policies do impact the percentage of time NPs spend providing direct patient care; the NP workforce role as USC providers has increased as SOP policies have changed; states with supportive

reimbursement policies have more NPs working as USC providers; and states with fewer NP supervision requirements have shorter patient travel times to USC providers.

Conclusion: The U.S. health care system must continue to evolve to address the growing demand for PC services. While strategies to increase the supply of PC providers may be an effective long-term solution, our findings suggest that NP SOP reform may be a viable and complementary strategy to increasing the capacity of the PC workforce, providing more immediate relief.

Christopher Harle, PhD, Chair

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LIST OF ABBREVIATIONS

AAMC	Association of American Medical Colleges
AANP	American Association of Nurse Practitioners
ACA	Affordable Care Act
AHRQ	Agency for Healthcare Research and Quality
APN	Advanced practice nurse
DHHS	Department of Health and Human Services
HRSA	Health Resources and Services Administration
IOM	Institute of Medicine
MEPS	Medical Expenditure Panel Survey
NCHWA	National Center for Health Workforce Analysis
NP	Nurse practitioner
NPPPI	Nurse Practitioner Professional Practice Index
NSSNP	National Sample Survey of Nurse Practitioners
PA	Physician assistant
PCP	Primary care provider
PC	Primary care
SOP	Scope-of-practice
USC	Usual source of care

Chapter 1: Laying the Foundation

Health

The World Health Organization defines "health" as "the state of complete physical, mental, and social well-being, and not merely the absence of disease or infirmity" (World Health Organization, 1948). Good health is a critical part of thriving societies and the cornerstone of well-performing economies (Byrne, 2004; Longest, 2009). Access to and timely receipt of medical care improves health outcomes and population health (Hadley, 1982; Kennedy, 2005; Lillie-Blanton & Hoffman, 2005).

However, access to medical care does not necessarily guarantee good health (Gold, 1998). Many medical conditions are profoundly influenced by other health determinants such as socioeconomic status, genetic predisposition, occupation, and environmental factors (Blum, 1974; Gold, 1998; Illich, 1982; Lalonde, 1981). While access to care is one of many health determinants, it is the intended goal of almost all health policies or programs in some way since access to care is the health determinant most easily influenced by health policies (Aday & Andersen, 1974; Gold, 1998).

Access to Health Care

Defining Access to Care

The concept of access to care is complex and multidimensional. Prior to the work of Aday and Andersen in 1974, which first operationalized the concept, "access" had been ill-defined and poorly understood (Aday & Andersen, 1974). Although access is an intended goal of most health policies or programs, it has become more of a political rather than an operational idea (Aday & Andersen, 1974).

There have been several attempts to establish systematic conceptual and empirical definitions of access to enable policymakers and consumers to monitor the effectiveness of various health policies and programs. One definition of access is the degree of "fit" between a patient's needs and the system's ability to meet those needs (Penchansky & Thomas, 1981; Ricketts & Goldsmith, 2005). This fit is measurable through five dimensions of access: 1) availability, 2) accessibility, 3) accommodation, 4) affordability, and 5) acceptability (Penchansky & Thomas, 1981).

"Availability" refers to the relationship of the volume and type of existing resources or services within the health system (Penchansky & Thomas, 1981). For example, health care providers, clinics, specialized treatment programs, and medical equipment are all resources that determine what health care services are available to patients. Availability does not alone equate to realized access, however, as other factors contribute to the ability of individual patients to actually use these available resources.

"Accessibility" refers to the relationship between the location of supply and the location of clients (Penchansky & Thomas, 1981). In other words, accessibility is the ease of receiving care and considers variables such as transportation resources and travel times (Penchansky & Thomas, 1981). "Accommodation" is defined as the relationship between the manner in which supply resources are organized to accept clients and their ability to accommodate these factors (Penchansky & Thomas, 1981). "Affordability" refers to the relationship between the price of services and the clients' ability to pay (Penchansky & Thomas, 1981). The last dimension of access is "acceptability" or the relationship between patients' attitudes about practice characteristics of providers and the actual characteristics of available providers (Penchansky & Thomas, 1981). Health

policies that address all five dimensions are likely to see the greatest improvements in realized access to health care.

The Affordable Care Act

In 2010, the Affordable Care Act (ACA) was signed into law with the overarching goal of improving the accessibility, affordability, and quality of the U.S. health care system. A key component of the ACA is expanded health insurance coverage in order to improve access to health care services (Shi & Singh, 2012). The main drivers of the ACA's insurance expansion involve increased Medicaid eligibility, tax credits for private health coverage purchased through health insurance exchanges, and the individual mandate (Sommers, Buchmueller, Decker, Carey, & Kronick, 2013). Nearly 50 million Americans were uninsured before the signing of the ACA (DeNavas-Walt, Proctor, & Smith, 2011). The uninsured rate dropped from 20.3% in the first quarter of 2012 to 13.2% by the first quarter of 2015 (ASPE, 2015). Within the first year and a half of the Medicaid expansion and tax credit provisions taking effect, 16.4 million previously uninsured Americans received health insurance coverage (ASPE, 2015). Thus, more Americans have been able to afford health insurance since the ACA's passage in 2010; however, the availability of resources for the newly insured is another critical factor affecting accessibility.

The ACA includes provisions for primary care workforce stabilization and expansion, but these provisions have not come to fruition (Goodson, 2010). Specifically, the ACA reauthorized Title VII, Section 747 of the Public Health Service Act, which includes programs that support the expansion of primary care capacity through the education and training of additional primary care providers (Goodson, 2010; Protection,

2010). These provisions were meant to increase the availability of health care resources, such as primary care providers, in order to ensure sufficient capacity of the health system to cope with the large influx of new patients resulting from health insurance expansion. However, congressional appropriations for these programs have been eliminated several times (Goodson, 2010).

The Primary Care Shortage

The Primary Care Physician Workforce

The Affordable Care Act emphasizes the importance of a strong primary care system and includes provisions to expand the primary care workforce. Primary care providers (PCPs)—including physicians, nurse practitioners (NPs), and physician assistants (PAs)—are trained to prevent disease, improve health outcomes and may lower the overall cost of health care (Friedberg, Hussey, & Schneider, 2010; Hansen, Groenewegen, Boerma, & Kringos, 2015; Starfield, Shi, Grover, & Macinko, 2005). PCPs deliver ongoing and continuous care within a family or community (Donaldson, 1996). They are trained to employ evidence-based clinical services that are key to preventing disease and improving overall health (Sanchez, 2007) by detecting symptoms early, identifying disease in early stages, and preventing or slowing disease progression that may result in costly tertiary care (Force, 1989). PCPs are also trained to coordinate patient care with specialists when diseases progress and more advanced medical care is required.

While the number of primary care physicians per capita in the United States is remarkably lower than other industrialized nations (Bodenheimer, Chen, & Bennett, 2009; Hansen et al., 2015; Starfield, Shi, Grover, et al., 2005), the number of *total*

physicians per capita is roughly the same as other industrialized nations (Starfield, Shi, Grover, et al., 2005). Primary care physicians in other industrialized nations comprise approximately 50% of the physician workforce (Starfield, Shi, & Macinko, 2005), but only 35% of the U.S. physician workforce practices in primary care (American College of Physicians, 2008; Bodenheimer et al., 2009). The percentage increases to 40 when adding primary care advanced practice providers such as NPs and PAs (Bodenheimer et al., 2009). Fewer and fewer medical graduates are choosing primary care specialties in large part due to growing clinical responsibilities in conjunction with declining salaries (Bodenheimer, Berenson, & Rudolf, 2007). This trend threatens the health care system's ability to ensure an adequate supply of primary care providers.

The Current Shortage

Health care workforce shortages are traditionally quantified by simple ratios, such as one primary care physician for every 2,500 people (Green, Savin, & Lu, 2013). These estimates attempt to equate the average daily patient demand with the supply of the physician appointment capacity (Green et al., 2013; Murray & Berwick, 2003). The U.S. Department of Health and Human Services (DHHS) recommends a ratio of at least 1 primary care physician per every 2,000 individuals (Carrier, Yee, & Stark, 2011). However, in order to meet this recommended ratio, an additional 17,722 primary care physicians on average are needed in shortage areas across the U.S. (Carrier et al., 2011). Furthermore, the current PCP shortage is expected to worsen in coming years as the nation's population grows and ages and as insurance coverage expands as a result of the ACA (Goldsmith, 2012; Green et al., 2013; Hofer, Abraham, & Moscovice, 2011; Mitka, 2007; Schwartz, 2012; Steinwald, 2008). For example, after accounting for changes in

health care demand resulting from the implementation of ACA, the estimated shortage of primary care physicians is expected to grow to nearly 45,000 by 2020 (Kirch, Henderson, & Dill, 2012).

The Demand-Capacity Mismatch

Primary care physicians perform a myriad of clinical and administrative tasks that impact the amount of time available for direct patient care. In fact, it is estimated that primary care physicians spend 50% of their time completing administrative or clerical work during a patient visit that adds limited direct value to the patient (Bodenheimer & Smith, 2013). Many primary care physicians also take on additional responsibilities such as serving as a faculty preceptor to train students or residents during a portion of their work week. Others may decide to pursue a career in research or administration. In short, in addition to the quantifiable PCP shortage, the PCP workforce is furthered burdened by extra demands and opportunities that impact their availability to provide direct patient care.

Policy Solutions

Many policy initiatives to address the growing gap between primary care service demand and workforce capacity have focused on reimbursement reform and improving the stressful primary care work life (Bodenheimer et al., 2009; Bodenheimer & Smith, 2013). Other strategies have focused on the use of primary care teams and technology to increase the capacity of primary care providers (Bodenheimer & Pham, 2010). The implementation of primary care teams for preventive, chronic, and acute issues is estimated to save 24% of a clinician's time (Bodenheimer & Smith, 2013).

The most commonly discussed strategy focuses on the educational pipeline and aims to increase the number of physician, NP, and PA graduates that go into and practice primary care (Bodenheimer et al., 2009). Among the 50 articles published since 2010 regarding the primary care shortage with recommendations for health workforce policy and planning (Bodenheimer et al., 2009), 42 of these articles include recommendations to increase the supply of physicians, NPs, or PAs (Bodenheimer & Smith, 2013). Although a viable strategy, increasing the number of clinicians is a long-term strategy due to the length of time it takes to train one provider. It can take upwards of 11 years to train a family medicine physician but only six years to train an advanced practice provider (i.e. nurse practitioners and physician assistants). However, there are strategies that may allow more immediate relieve to the primary care system such as scope-of-practice reform for non-physician providers.

Nurse Practitioner Scope-of-practice

Workforce policy and planning initiatives that focus on growing primary care capacity by fully leveraging the existing workforce may provide more immediate relief to the primary care shortage than growing the PCP pipeline. New and innovative models for care delivery that fully leverage advanced practice providers and existing resources—such as team-based care—may be viable solutions to strengthening the capacity of the primary care system. One such strategy is to expand the role of non-physician providers such as NPs.

NPs are registered nurses (RNs) with advanced academic and clinical experience that enables them to diagnose and manage acute, episodic and chronic illness, either independently or as part of a health care team. NPs' advanced training and clinical

expertise allow them to provide complementary care and in some cases an alternative to physician care (Newhouse et al., 2011). In fact, several studies have concluded that health outcomes are similar between NPs and physicians (Cassidy, 2012; Dierick-van Daele, Metsemakers, Derckx, Spreeuwenberg, & Vrijhoef, 2009; Horrocks, Anderson, & Salisbury, 2002; Laurant et al., 2005). Additionally, health status, treatment practices, and prescribing behaviors are typically consistent between NPs and physicians (Cassidy, 2012; Cipher, Hooker, & Guerra, 2006; Naylor & Kurtzman, 2010; Running, Kipp, & Mercer, 2006). Research has demonstrated that receiving primary care services and having a usual source of care is more important to patients than the type of provider (Cassidy, 2012). In fact, many NP patients have reported higher levels of satisfaction with their care (Fanta et al., 2006; Lenz, Mundinger, Kane, Hopkins, & Lin, 2004; Litaker et al., 2003; Mundinger et al., 2000; Pinkerton & Bush, 2000; Varughese, Byczkowski, Wittkugel, Kotagal, & Dean Kurth, 2006). Other studies have concluded that NPs outperform physicians on measures of patient follow-up, time spent with patients, and provisions for screening, assessment, and counseling services (Cassidy, 2012; Lenz et al., 2004; Naylor & Kurtzman, 2010).

The growth of the primary care NP workforce is dramatically outpacing that of the primary care physician workforce. The demand for primary care services is expected to grow approximately 14% between 2010 and 2020, but there is only an anticipated 8% growth for the primary care physician workforce (National Center for Health Workforce Analysis, 2013). On the other hand, the supply of primary care NPs is expected to grow by 58% over this same time period (National Center for Health Workforce Analysis, 2013). Despite substantial growth within the primary care NP workforce, state-level

regulatory policies in many states restrict the ability of NPs to practice in a manner consistent with their education and training.

Chapter 2: Measuring Nurse Practitioner Scope-of-practice

Professional Licensing

Health care professionals have authority to provide services through licenses administered by their respective states. States were first provided the right to regulate health care professionals by the U.S. Supreme Court in 1889 through licensing to ensure the welfare of people.[1] These regulations were designed to ensure a certain standard for health care quality and patient safety. In 1963, professional licensing was upheld by the U.S. Supreme Court as a mechanism for administering and enforcing standards among the health professions within a state.[2]

The authority to regulate professional licensing is generally delegated to state professional licensing boards that represent each respective profession. These licensing boards establish "Professional Practice Acts" which typically require that health professionals hold and maintain a valid license to practice within a given state. These professional practice acts contain scope-of-practice (SOP) regulations that delineate the clinical tasks a provider is able to perform and under what conditions they may provide such services. These SOP regulations may or may not be consistent with national academic standards.

Education and Academic Standards

Health professionals must graduate from an accredited institution and meet basic academic standards in order to be eligible for licensure in any state. These academic standards are set by accrediting bodies for each profession such as the American

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[1] *Dent v. West Virginia*, 129 U.S. 114, 122 (1889).
[2] *Goldfarb v. Virginia State Bar*, 421 U.S. 773, 792 (1975); *see, also, Ferguson v. Skrupa*, 372 U.S. 726, 731 (1963).

Associations of Colleges of Nursing (CCNE) and the American Association of Medical Colleges (AAMC). After completing didactic and clinical training and passing national board examinations, health professional graduates may seek licensure from their state licensing boards.

Even though practitioners may have passed national board examinations and demonstrated their competencies in a variety of clinical activities, state SOP regulations do not always permit these newly licensed providers to perform at the level in which they were trained. For example, one of the core competencies for all NP programs accredited by the American Association of Nursing Colleges (AANC) is, "independent practice managing previously diagnosed and undiagnosed patients" (Thomas et al., 2012). As a part of this competency, NP programs require curricular elements specific to screening and diagnostics (Thomas et al., 2012). However, many states, such as Texas and Georgia, do not allow NPs the ability to independently practice and manage patients, including the ordering of diagnostic tests. Further, not only are SOP regulations often inconsistent with national academic standards, but they also vary by state.

Current NP Professional Practice Environment

The Institute of Medicine (IOM) and the National Council of State Boards of Nursing recommend that state regulations and licensure laws allow "full practice authority" to NPs. Full practice authority, as defined by the American Association of Nurse Practitioners (AANP), means that the state regulations allow NPs to evaluate patients, diagnose, order, and interpret diagnostic tests, initiate and manage treatments—including prescribing medications—under the exclusive licensure authority of the state board of nursing (American Association of Nurse Practitioners, 2015).

As of March 2017, only 22 states and the District of Columbia have SOP regulations that allow NP full practice authority (American Association of Nurse Practitioners, 2015). Seventeen states have SOP regulations that limit at least one element of NP practice (reduced practice) and require a collaborative agreement with a physician in order to provide patient care (American Association of Nurse Practitioners, 2015). The remaining 12 states limit at least one element of NP practice and require direct supervision, delegation, or team-based management by a physician in order for the NP to provide patient care (restricted practice) (American Association of Nurse Practitioners, 2015). The variation in state SOP regulations as defined by AANP is illustrated in figure 2.1.

The wide variation in SOP across the country suggests that NP SOP regulations vary for reasons other than education and training. In fact, the Institute of Medicine (IOM) states, "what nurse practitioners are able to do once they graduate varies widely for reasons that are related not to their ability, education or training, or safety concerns, but to the political decisions of the state in which they work" (Institute of Medicine, 2011). Recently, state and federal policy initiatives have focused on removing SOP barriers for NPs in order to improve health care delivery and access to care.

Scope-of-Practice Reform

In recent decades, non-physician providers such as NPs, PAs, and pharmacists have undergone a process of "professionalization." Hodson and Sullivan define professionalization as the "effort by an occupational group to raise its collective standing by taking on the characteristics of a profession" (Hodson & Sullivan, 2012). The professionalism process is characterized by several steps including:

- formation of a professional organization and lobbying the government and the public for increased professional standing;
- standardization of the body of knowledge through more uniform curriculum requirements and training, publication of journals, engagement in research, and creation of examination requirements for the profession; and
- convincing the public by creating certification requirements that the occupation possesses appropriate professional knowledge and by licensure through public agencies (Health Resources and Services Administration, 2004; Hodson & Sullivan, 2012).

Many health professional organizations such as the AANP and IOM have made SOP reform a top priority as a part of the professionalization process. However, these efforts have not historically been supported by compelling evidence generated from strong research. Professional organizations and policymakers must thoroughly review current research on the impact of changes to NP SOP before undertaking large-scale SOP reforms intended to ease the burden of the primary care workforce shortage.

Literature Review

Policy recommendations have called for SOP reform in order to effectively use NPs and to expand the capacity of the primary care system (Dower, Moore, & Langelier, 2013; Naylor & Kurtzman, 2010; Pohl, Hanson, Newland, & Cronenwett, 2010). However, the current literature is limited and does not clearly demonstrate how NP SOP reform impacts health care delivery. Between 1997 and 2015 only 15 articles have examined the impact of state NP SOP regulations on health care delivery (Xue, Ye, Brewer, & Spetz, 2016). The literature has focused on the impact these regulation have

on four key issues: 1) NP workforce; 2) NP care provision; 3) health care costs, and 4) access to care and health care utilization (Xue et al., 2016).

Evidence has consistently shown that states that offer the greatest practice authority have the largest supply and greatest growth within the NP workforce (Auerbach, 2000; Kuo, Loresto, Rounds, & Goodwin, 2013; Reagan & Salsberry, 2013; Stange, 2014). One study specifically examined the migration patterns of NPs and concluded that NPs are more likely to move from states without controlled substance prescriptive authority to states that offer this level of professional independence (Perry, 2012). The finding suggests that less restrictive states may be better positioned to retain their primary care workforce and improve the supply of primary care providers. On the other hand, restrictive SOP regulations may be associated with a reduction in the supply and growth of the NP workforce (Reagan & Salsberry, 2013).

States that grant higher levels of NP practice authority have also been shown to increase NP primary care provision. In other words, there is an association between higher levels of practice authority and increased NP participation in primary care settings (Kuo et al., 2013; Pan, Straub, & Geller, 1997). Kuo et al., concluded that states with the least restrictive regulations of NP practice had a 2.5 fold greater likelihood of patients receiving their primary care from NPs than did the most restrictive states (Kuo et al., 2013). Also, states with full SOP regulations saw an increase from 0.6% to 5.3% in NPs providing primary care for Medicare fee-for-service patients whereas states with the most restrictive policy environment only saw an increase from 0.2% to 2.5% (Kuo et al., 2013). Community health centers, the major provider of primary care services for medically underserved populations, are more likely to hire additional NPs in states with

more positive practice environments (Shi & Samuels, 1997). This is consistent with the recent finding that staffing composition in community health centers is largely influenced by NP SOP regulations (Ku, Frogner, Steinmetz, & Pittman, 2015).

The impact of NP SOP regulations on health care costs has been studied by examining various measures of cost including provider compensation, office-based visit expenditures, and retail clinic costs (Xue et al., 2016). States with the most restrictive NP SOP regulations have seen the highest costs of care in retail clinics when evaluating the combined insurer expenditure and patient out-of-pocket cost (Spetz, Parente, Town, & Bazarko, 2013). Dueker et al, found that granting prescriptive authority for controlled substances to advanced practice nurses (APN) was associated with lower earnings for APNs as well as physicians (Dueker, Jacox, Kalist, & Spurr, 2005). On the other hand, Perry et al, reported that expanded SOP regulation granting prescriptive authority for NPs was associated with higher incomes for NPs and lower incomes for physicians and physician assistants (Perry, 2009). These different findings are likely due to the use of different samples as well as variations in the operational definition of scope-of-practice. Additional research is needed to settle the dispute and better understand the relationship between SOP regulations and provider compensation.

Only one published study has longitudinally evaluated the impact of NP SOP regulations on primary care access and utilization (Xue et al., 2016). For this study, access was defined as having a usual source of care (USC) (Stange, 2014). In this context, utilization was measured by the use of preventive services in office-based settings. This study found that expansion in prescriptive authority for NPs was associated with modest increases in utilization and expenditure, but there was no conclusive

evidence of an impact of NP SOP regulations on access to care (Stange, 2014). Another important finding from the study was that a larger supply of NPs alone did not seem to have any effect on health care utilization (Stange, 2014). However, the greatest effect was recorded in states that had both a larger supply of NPs as well as greater prescriptive authority for NPs.

Gaps in the Literature

While a pattern is emerging that suggests there may be some association between NP SOP regulation and various aspects of health care delivery, the literature is sparse and has notable limitations (Xue et al., 2016). First, cross-sectional research designs have been the predominant methodological approach to studying the impact of NP SOP regulations on health care delivery in large part due to limitations in available data. Cross-sectional research has the advantage of allowing broader sampling of participants, due to faster and cheaper studies that involve less participant burden (Wang et al., 2017). However, cross-sectional research designs are not ideal for studying theories of change (Wang et al., 2017), which in the case of informing policy reform for NP SOP regulations is the ultimate goal. These cross sectional research designs should not be dismissed altogether as they do provide important information about the relationship between NP SOP policies and measures of health care delivery (Wang et al., 2017).

Recognizing the existence of group differences and relationships allows researchers the ability to generate hypotheses that drive future researcher aimed at identifying causal relationships between NP SOP and outcomes. On the other hand, longitudinal or time-series designs "can, with certain precautions, improve one's confidence in inferences about causality" (Wang et al., 2017). Also, in the case of NP

SOP reform, it is important that researchers attempt to study how changes to or implementation of new NP SOP policies affect the health system over time.

Perhaps one of the most important limitations is that this area of research has not been grounded with a consistent definition of scope-of-practice. Researchers have employed an array of measures to quantify the regulatory environment within a state. The most commonly used approach to defining NP SOP is by the use of categorical coding to identify the presence or absence of similar components of NP practice. For example, the AANP categorizes NP professional practice by full practice, reduced practice, or restricted practice (American Association of Nurse Practitioners, 2014). Other studies assign a binary variable for only one component of NP practice such as prescriptive authority. Another method of measuring NP SOP is through an index which quantifies the professional practice environment for NPs in a given state by using scoring elements to assign points to categories such as legal status, reimbursement, and prescriptive authority. A systematic literature review published in 2016 identified 15 studies that examined the relationship between NP SOP and various measures of health care delivery. Of these 15 articles, there were seven different methods or measures used for quantifying NP SOP.

Furthermore, the operational definitions of NP SOP vary within the different types of measures. For example, there were three studies (Dueker et al., 2005; Krein, 1999; Perry, 2012) that quantified NP SOP through the creation of a binary variable where the researcher coded a value of 1 if the state granted NPs prescriptive authority and a 0 otherwise. Krein (1999) defined and assigned the binary variable for "prescriptive authority" a value of 1 if NPs were granted any level of prescriptive authority whereas

Perry (2012) assigned the binary variable for "prescriptive authority" a value of 1 only if NPs were permitted to prescribe controlled substances (Krein, 1999; Perry, 2012).

Not only have researchers implemented an array of SOP measures, but they have discussed study findings in terms that are outside the scope of the operational definitions employed for the research. For example, Xue and colleagues summarized this body of work in their recent systematic literature review by writing:

> Our review of the available evidence revealed several consistent and promising patterns with regard to the potential impact of state NP SOP regulation on health care delivery. This evidence generally supports recommendations consistent with recent trends in which state legislatures have reduced restrictions on SOP regulations to provide a more independent NP practice environment as a viable and effective strategy to increase primary care capacity and health care utilization and potentially reduce costs (Gadbois, Miller, Tyler, & Intrator, 2015; Xue et al., 2016).

In summary, while recent studies have contributed to the literature about specific elements of SOP policy, there remains a gap in the literature regarding the impact of the many SOP policies. Moving forward, a more consistent approach to quantifying NP SOP regulations and the NP professional practice environment may better enable researchers and policymakers to assess this body of knowledge and translate meaningful research findings into policy action.

NP Scope-of-practice Domains

The SOP regulations that govern NPs have been systematically documented in reports within the journal *The Nurse Practitioner: The American Journal of Primary Healthcare* for over 28 years. Furthermore, these reports provide a comprehensive list of SOP policies and legislative changes to NP professional practice which are categorized into 3 domains of NP practice: legal status; reimbursement; and prescriptive authority. Each of these 3 domains represents a critical component of NP practice (figure 2.2)

The domain "legal status" generally refers to policies that describe the professional relationship between NPs and physicians including their ability to practice independently. This domain also defines various requirements for obtaining NP licensure and defines the licensing board which oversees this process. According to Sekscenski et al, legal status is a driver of the other two domains (Sekscenski, Sansom, Bazell, Salmon, & Mullan, 1994). For example, if a state's professional practice act contains legal descriptions that are permissive in language or privilege, it would be reasonable to expect that reimbursement policies and prescriptive privileges would be commensurately liberal. The most common regulation discussed in the domain of legal status is "supervision, which is generally defined by the states as the relationship with physicians.

The second domain characterizing NP professional practice regulations is reimbursement. "Reimbursement for services is a complex issue affected by state and federal regulations, by State and Federal reimbursement and insurance law, by individual insurance company practice, and by employer choices" (Health Resources and Services Administration, 2004). Reimbursement policies "dictate how, where, by whom, and under what conditions health services are provided" (Health Resources and Services Administration, 2004). For example, insurance providers including federal programs such as Medicaid may only reimburse NPs a fraction of what they may reimburse physicians for identical services. In Arkansas, for example, the Medicaid program only reimburses NPs 75% of the total reimbursement (Yee, Boukus, Cross, & Samuel, 2013). As such, NPs may be pressured to provide services as "incident-to" a physician's license so that health care organizations may receive 100% reimbursement from payers. As

such, these reimbursement practices are likely to discourage NPs from establishing independent practices and providing services as independent providers (Yee et al., 2013).

The third domain of NP professional practice regulations is prescriptive authority. Academic standards for NP programs upheld by the AANC include advanced clinical training in both diagnosis and treatment of a variety of conditions. However, in order to effectively treat patients, NPs must have the ability to prescribe treatment plans including the medications that may accompany those treatments. For example, an NP may see a patient with hypertension in a small practice in rural Oklahoma and would like to prescribe 5 mg of Lisinopril (a commonly prescribed medication to treat hypertension). However, she/he is unable to do so without the supervision of a physician due to state NP SOP policies. On the other hand, an NP working in rural Maine may have an identical patient and would have no problem prescribing Lisinopril to their hypertensive patient as Maine does not restrict NP prescribing.

There have been several attempts to create a comprehensive and objective system for scoring NP SOP that covers all three domains of NP professional practice. In 1994, Sekscenski and colleagues published an analysis of state practice environments for NPs, nurse midwives, and PAs (Sekscenski et al., 1994). In this study, Sekscenski quantified NP professional practice through the creation of the Nurse Practitioner Professional Practice Index (NPPPI). The 100-point index measured NP professional practice through the use of 26 scoring elements categorized into the three domains previously described, where higher scores equate to more supportive policies for NP professional practice. In 2002, HRSA revised the original NPPPI scoring system to "reveal smaller, more subtle differences and distinctions in professional practice across the States" (Health Resources

and Services Administration, 2004, p. 21). HRSA's refined NPPPI retained the 100-point scoring system, but revised the weighting system to more evenly distribute the 26 scoring elements and weight of each domain (table 2.1).

As illustrated in table 2.1, there are 14 scoring elements that pertain to the professional independence and autonomy provided to NPs which make up the domain "legal status." For example, the domain documents policies that provide autonomous practice, full recognition of NP profession through licensure, and policies that define NPs' legal relationship with physicians. Legal status represents 35 total points in the NPPPI.

The "reimbursement" domain contains four scoring elements that identify reimbursement ability for NPs with government and 3rd party payers. Reimbursement represents 35 total points in the NPPPI. The NPPPI contains nine scoring elements for "prescriptive authority" which describes how NPs receive prescriptive authority, the type of medications they may prescribe, and how this process is regulated. This domain is allocated 30 points in the NPPPI. The full detailed methodology for the development of the NPPPI is outlined in HRSA's 2004 report, *A Comparison of Changes in the Professional Practice of Nurse Practitioners, Physician Assistants, and Certified Nurse Midwives: 1992 and 2000* (Health Resources and Services Administration, 2004).

The NPPPI is more comprehensive than the commonly used categorical or binary coding methods that define only one or two domains of NP professional practice. With 26 scoring elements (SOP policies), the NPPPI is able to reflect small differences that may impact health care delivery. Furthermore, the domains of legal status, reimbursement, and prescriptive authority closely align with the reporting structure used

in the legislative updates of *The Nurse Practitioner*, which has enabled researchers to update the NPPPI every year through 2015.

Original Contribution

This dissertation contributes to the existing literature on NP SOP through two research studies that are designed to fill three important gaps previously identified in the literature. First and foremost, there is a limited research available that evaluates the relationship between NP SOP policies and the roles of NPs in healthcare delivery. Second, there are inconsistent operational definitions of NP SOP policies within the existing literature. Lastly, without high quality longitudinal data, most studies have relied on cross-sectional research designs, which limit the ability to evaluate the effect of policy changes or NP SOP reform on measures of health care delivery. This dissertation attempts to fill these identified by gaps by examining various measures of SOP within the three domains of NP practice using longitudinal data, contributing to limited literature on this topic.

This dissertation is grounded in a conceptual definition of NP SOP that encompasses all 3 critical components of NP practice required to fully leverage the NP workforce in a manner consistent with their training. The recently updated NPPPI is composed of 26 specific SOP policies within the three domains of legal status, reimbursement, and prescriptive authority. This comprehensive index enables researchers to evaluate specific NP SOP policies or assess the index as an aggregate of each of the NP SOP policies. The research studies contained in this dissertation take into consideration the complexity of NP SOP regulations that have been frequently

overlooked in previous research. The NPPPI enables more comprehensive analyses of NP SOP regulations.

Secondly, to the author's knowledge no previous research has studied the relationships between NP SOP regulations and the following indicators:

1. division of work (time spent delivering patient care);
2. delivery of preventive care;
3. the role of NPs as usual source of care (USC) providers; and
4. patient travel times.

The IOM has suggested that providing NPs with the ability to work in expanded roles might improve the primary care workforce shortage (Institute of Medicine, 2011). However, each of these measures has important implications for access to care and should be closely examined to inform policy positions and future policy recommendations. For example, the first research study presented in Chapter 3 uses cross-sectional data from the NSSNP to assess the relationship between NP professional practice regulations and both the percent time spent providing patient care and the delivery of preventive care services.

Previous research has concluded that states with SOP policies that afforded higher levels of professional independence in conjunction with a larger supply of non-physician providers observed greater utilization of primary care services (Stange, 2014). These findings suggest that SOP regulations are important because they influence the division of work and the activities in which healthcare providers are allowed to engage. For example, physicians may reduce the number of hours spent on patient care in response to the adoption of new public policies (Garthwaite, 2012). If the primary goal of SOP

reform is to expand the role of non-physician providers in order to reduce the burden of the primary care workforce shortage and increase primary care workforce capacity, then policy makers must understand how these regulations influence both the percent of providers' time spent delivering patient care and the delivery of preventive services.

Lastly, the limited use of longitudinal and time-series research methods poses a significant limitation to the current literature. The second study in this dissertation conducts a difference-in-differences analysis of patient level data from the Medical Expenditure Panel Survey (MEPS) aggregated to the state level with intervention and comparisons states, a method widely used to identify the impact of policy changes (Buckley & Shang, 2003; French & Heagerty, 2008). This study evaluates the impact of NP SOP policies (i.e. reimbursement and supervision) on primary care access as defined by USC provider type, appointment availability, and travel times.

Tables and Figures

Figure 2.1. Nurse Practitioner Scope-of-practice Authority by state as defined by AANP, 2017.

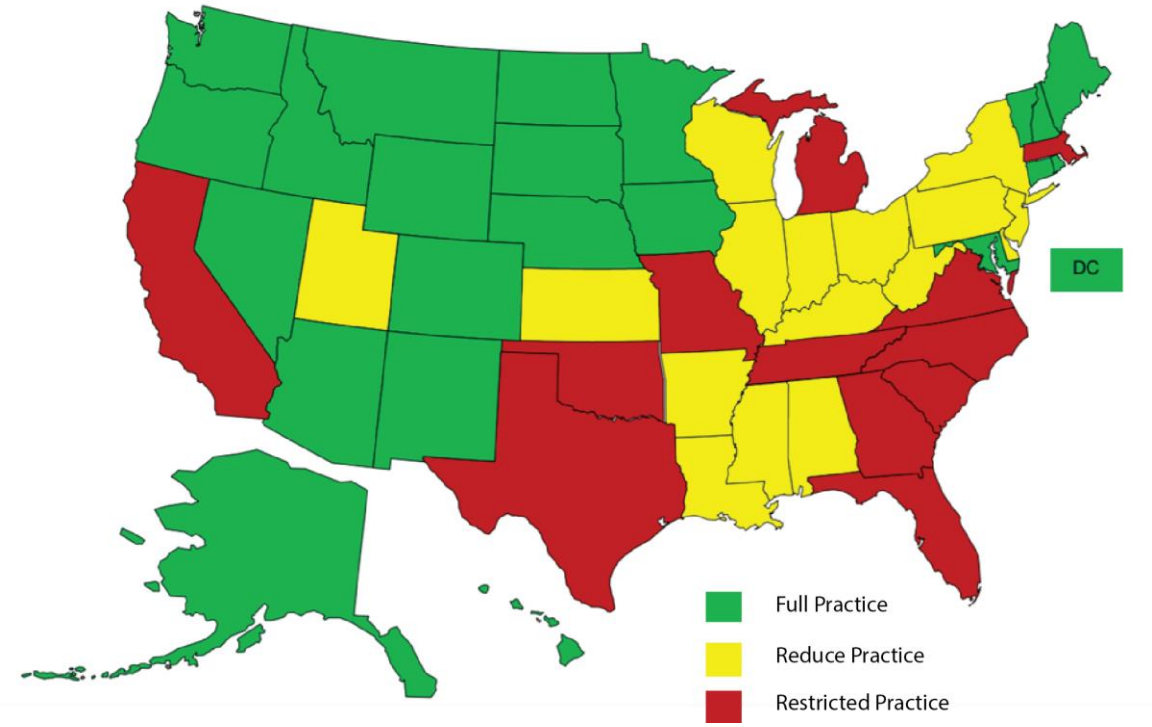


Figure 2.2. The three domains of nurse practitioner professional practice regulations.

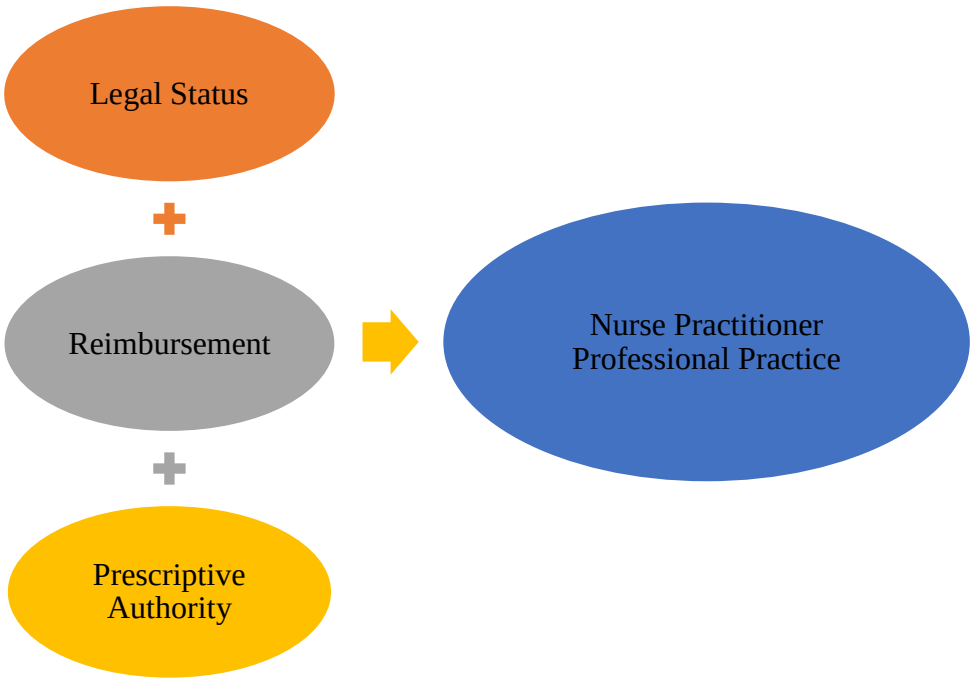


Table 2.1*:*

The Nurse Practitioner Professional Practice Index, Scoring Elements

	NPPPI Scoring Element	**Points**
Legal Status (Score; 5-35)	How licensed	
	Licensed as NP	3
	Licensed as Nurse and Approved as NP	2
	RN license only	1
	Relationship with Physicians:	
	No mention of physician in legislation	5
	Collaborative language	4
	Supervisory language	2
	Regulated by:	
	State Board of Nursing alone or Board of APN	3
	State Board of Nursing with another entity	2
	Board of Medicine or other	1
	Practice Agreements	
	No written practice agreement required	3
	Written practice agreement available on site	2
	Written practice agreement filed with regulatory agency	1
	Review of Records by Physician	
	No legislated time requirement for review	3
	Periodic/regular reviews	2
	Strict/daily	1
	Title protection	3
	Autonomous practice possible	7
	Electronic communication permitted/indirect supervision	1
	National certification required	1
	Master's degree required	1
	Ratios > 2 in outpatient settings or not legislated	1
	Hospital privileges protected in legislation	1
	Can refer directly for health/medical services	2
	Can order or perform diagnostic or lab tests	2
Reimbursement (Score; 5-35)	Medicare	5
	Legal right to be listed on panels as PCP	5
	Medicaid % x 10	10
	Language permits reimbursement by 3rd party or HMO	15

Table 2.1:

Continued

	NPPPI Scoring Element	Points
Rx Authority (Score; 5-30)	How Received:	
	Automatic	4
	Application or approval required	2
	How Defined:	
	Defined by legislation/physician agreement does not determine	5
	Collaborative agreement defines	4
	Supervisory agreement defines	3
	Defined formulary (inclusive or exclusive)	1
	Type of Authority	
	Full authority within scope (II-V and Legend)	12
	Extensive authority (III-V and Legend)	9
	Limited authority (IV-V and Legend)	6
	Restricted (V and Legend)	3
	Legends only	1
	Uses own DEA number	3
	Durable medical equipment/devices	1
	Sign for samples	1
	Distribute samples	1
	NP signs prescription	2
	Continuing education requirements	1
	NPPPI Total	9-100

Chapter 3: Evaluating the Relationship between Nurse Practitioner Scope-of-practice Regulations & Service Delivery

Introduction

Americans across the country are not consistently receiving recommended health care services (Centers for Disease Control and Prevention, 2013; McGlynn et al., 2003; Ostbye et al., 2005). Clinical guidelines have been established to facilitate more consistent and effective medical practice; however, Americans' health care is inconsistent with these recommended processes for basic care (McGlynn et al., 2003). In fact, many Americans receive just half of the recommended services for acute, preventive, and chronic disease care (McGlynn et al., 2003).

One major limitation to delivering these services is the time constraints for physicians in primary care (Ostbye et al., 2005; Yarnall, Pollak, Ostbye, Krause, & Michener, 2003). Primary care physicians caring for a standard patient panel size of 2,500 individuals would require an additional 108.5 hours per week (21.7 hours/day) to meet national clinical care guidelines for their patients (Yarnall et al., 2009). Moreover, family physicians must often prioritize and attend to acute conditions, with less time available for the treatment and delivery of chronic disease or preventive care (Yarnall et al., 2009).

One possible solution to addressing time constraints faced by PCPs is the utilization of other advanced practice providers (i.e. physician assistants and nurse practitioners) in expanded roles who are able to provide additional capacity in direct patient care and focus on preventive service delivery. Previous research has demonstrated that NP treatment practices, prescribing behaviors, and health outcomes are

consistent with their physician counterparts (Cassidy, 2012; Cipher et al., 2006; Dierick-van Daele et al., 2009; Laurant et al., 2005; Naylor & Kurtzman, 2010; Running et al., 2006). By utilizing advanced practice providers, such as NPs, PC physicians may be available to provide care to the sickest patients and manage the most complicated cases (Yarnall et al., 2009). As such, expanded roles for NPs may be viable solution to alleviating, to some extent, physician time constraints and thus potentially increase receipt of recommended care.

Expanding the roles of non-physician providers including NPs depends largely on NP scope-of-practice reform. There are a myriad of state-level regulations that govern NPs' ability to take on additional responsibilities and fulfill expanded roles (Bodenheimer & Smith, 2013). These regulations, known as scope-of-practice (SOP), delineate the clinical tasks and responsibilities NPs are allowed to perform and under what circumstances they may perform such procedures (Bodenheimer & Smith, 2013).

NP SOP regulations consist of three broad domains including: legal status (professional independence); reimbursement; and prescriptive authority (Health Resources and Services Administration, 2004; Sekscenski et al., 1994). While NPs are trained to national academic standards, their clinical practice is regulated by state SOP regulations. (Institute of Medicine, 2011). Some organizations, such as the Institute of Medicine and the American Association of Nurse Practitioners, have called for SOP reform in order to expanded NPs' clinical roles; (Dower et al., 2013; Naylor & Kurtzman, 2010; Pohl et al., 2010). However, the relationship between SOP regulations and health service delivery is not well understood. Therefore, this article examines the relationship

between NP SOP regulations and the type of services NPs provide in primary care settings.

Previous studies have shown an association between higher levels of practice authority (legal status) for NPs and increased NP participation in primary care settings (Kuo et al., 2013; Pan et al., 1997). However, it is less clear how these regulations relate to the type of services being delivered. In 2012, a qualitative study explored the differences in roles of NPs within six states that varied in their SOP policies for NPs (Yee, Boukus, D. Cross, & D. Samuel, 2013). Yee et al. found that SOP policies pertaining to supervision requirements or professional independence (legal status) did not relate to the types of primary care services delivered by NPs. The study did note that these regulations may reduce NP efficiency due to the additional oversight and subsequent paperwork required by both NPs and physicians (Yee et al., 2013).

On the other hand, the study suggested that reimbursement policies may be more directly related to the type of services an NP may provide. For example, Arkansas does not recognize NPs as primary care providers by traditional Medicaid and therefore will not reimburse them for various primary care services such as streptococcal screenings or influenza swabs (Yee et al., 2013). Although NPs are not prohibited from providing these services, reimbursement policies may discourage or limit their ability to deliver them. The study conducted by Yee et al., suggests there may be a relationship between reimbursement policies and types of services being delivered by NPs, but this relationship should be studied quantitatively to better understand how NP SOP regulations influence NP service delivery.

To our knowledge, no other study has empirically examined the relationship between NP SOP regulations and the delivery of preventive services by NPs in primary care settings. Our goal was to evaluate the relationship between NP SOP regulations and the delivery of preventive care by NPs. To examine this relationship, our study used data from the National Sample Survey of Nurse Practitioners (NSSNP) and the Nurse Practitioner Professional Practice Index (NPPPI). The NPPPI is a recently updated measurement tool that provides researchers with the ability to study broad measures of NP SOP as well as examine specific SOP policies within the 3 domains of NP professional practice (legal status, reimbursement, and prescriptive authority).

Methods

We conducted a cross-sectional analysis of state-level NP SOP regulations and NP service delivery in primary care settings.

Data Sources

We used secondary data from the 2012 NSSNP coupled with supplemental data from the Area Health Resource File (AHRF) and the NPPPI. The NSSNP contains individual level information on NPs in regard to their training, employment, and practice patterns. The study population included 22,000 NPs who were actively licensed to practice in the U.S. in 2011. A total of 12,923 NPs responded to the survey which resulted in a total response rate of 60.1 percent (Chattopadhyay, Zangaro, & White, 2015). A subsample of 11,091 respondents reported working as an NP for pay and made up the final sample for analyses in this study.

We measured SOP using the NPPPI, which quantifies the three domains of NP professional practice by state. In addition to examining state-level SOP regulations, we

included state-level variables from the AHRF file, which are important indicators of health system capacity or demand such as uninsured rates or providers per 100,000 population. We obtained the restricted version of the NSSNP, which identifies the state in which the NP resides. This allowed us to merge the survey data with the NPPPI and AHRF data. Additional methodological details regarding survey development and data collection for the NSSNP are available through HRSA's Data Warehouse (Health Resources and Services Administration, 2012).

Outcome Measures

The first outcome measure, capacity for patient care, is represented by the percentage of time an NP reported spending in direct patient care/documentation. NSSNP survey respondents were asked to report the percentage of their time spent on each of the following work activities: (1) patient care/documentation; (2) teaching/precepting/orienting; (3) supervision/management/administration; and (4) other. A binary variable was created to evaluate whether or not direct patient care comprised at least 85% of an NP's work. The median value of 85% for NP's reported time spent in patient care/documentation was selected as the threshold for creation of the binary variable. Not only was 85% the median of the data, but it also fell within the average range of 82-86% of NP time spent in patient care/documentation published in previous research (Buerhaus, DesRoches, Dittus, & Donelan, 2015). This binary variable was coded with a value of 1 if the respondent reported spending greater than 85% of their time in patient care/documentation and a value of 0 if they reported spending 85% or less of their time in patient care/documentation.

The second outcome measure, preventive care delivery, was drawn from the responses from the NSSNP question: "*Thinking about your main NP position, for how many of your patients do you provide preventative care, including screening and immunizations?*" Responses were recorded as an ordinal measure with values ranging from 1 to 4 (1=most patients, 2=some patients, 3= few patients, and 4=no patients).

Primary Independent Measure

The NPPPI was the primary independent variable for this study to quantify NP scope-of-practice within a given state. The NPPPI is a 0 to 100 scale, based on 26 scoring elements, each of which relate to one of the three domains (legal status, reimbursement, and prescriptive authority). Each element receives a weighted value based a scoring system developed by researchers in collaboration with HRSA (Hoyt, McIntyer, & Hachey, 2016). The purpose of weighting values for various scoring-elements and domains within the NPPPI is to ensure that SOP policies that have been demonstrated to be more relevant to NP practice are more prominent within the index. For example, "language that permits reimbursement by 3rd party payors" may receive a weighted score of 15 points as it is believed to more directly impact NP practice whereas "hospital privileges protected in state legislation" may only receive a weighted score of 1 because these tend to be more directly associated with organizational policies as compared to state policies. Detailed scoring methodology for the NPPPI is discussed in previous publications (Health Resources and Services Administration, 2004).

Categorical coding to identify the presence or absence of similar components of NP professional practice is a more commonly used approach to measuring NP SOP regulations (Xue et al., 2016). Therefore, NP SOP policies were evaluated through a

five-level categorical variable created by HRSA in conjunction with the NPPPI. The total NPPPI score was converted to the five-level categorical variable based on predetermined values defined by HRSA (Restrictive <49, Limiting=50-69 Satisfactory=70-79, Favorable=80-89, and Excellent >90) (Health Resources and Services Administration, 2004). These categories were created to allow policymakers and researchers a mechanism to characterize the general practice environments in different states and generally conform to characterizations of the practice environments in states by knowledgeable NPs (Health Resources and Services Administration, 2004). Table 3.1 provides the overall NPPPI scores as well as the score for each NPPPI domain. Figure 3.1 illustrates the state professional practice categories.

Model Covariates

Additional variables from the NSSNP were analyzed to describe the population, evaluate their relationship to provider capacity, and to adjust for potential confounding in the relationship between state NP professional practice environment and the outcomes of interest. Provider-level covariates included gender, race/ethnicity, age, years of experience, highest nursing degree, practice setting, practice location, compensation type, specialty, marital status, and income. These provider demographic and practice characteristics are similar to prior studies of differences in work activities between primary care NPs and physicians (Buerhaus et al., 2015). Additional information on how these variables were constructed is described in detail through HRSA's Data Warehouse (Health Resources and Services Administration, 2012).

Respondents are nested in different states with varying health system and population characteristics. States' health system and population characteristics have been

demonstrated to influence health service utilization (Aday & Andersen, 1974) and thus may be related to NP practice patterns. Therefore, several state-level variables that are in line with Aday and Andersen's model of health service utilization and that have been used in similar studies were extracted from the AHRF file (Aday & Andersen, 1974; Andersen, 1995; Kuo et al., 2013; Reagan & Salsberry, 2013; Spetz, Fraher, Li, & Bates, 2015; Spetz, Nooney, Fry, & Sommers, 2015; Stange, 2014). These covariates include percent in poverty, share over age 65, providers per 100,000 population, unemployment rate, median household income, percent urban population, and percent uninsured under the age of 65.

Statistical Analyses

We performed descriptive statistics on all study variables in order to summarize and describe the data. Additionally, we used generalized linear mixed effects models to analyze the relationship between outcomes and NP professional practice categories. Linear mixed effects models can account for correlations introduced by the hierarchical structure of the data, in this case respondents were stratified in the sampling frame by state. The primary independent measure for NP professional practice category as well as provider characteristics were evaluated as fixed effects. In addition to NP professional practice categories, covariates at the state-level (i.e. percent in poverty, share over age 65, providers per 100,000 population, unemployment rate, median household income, percent urban population, and percent uninsured under the age of 65) were added to the model as fixed effects to control for state-level variables of health system demand and capacity as well as population characteristics that may theoretically influence NP practice patterns.

Nurse practitioners were clustered (nested) within states since NPs located in the same state are subject to the same professional practice regulations. Thus, we used a random intercept to adjust for within state correlations in order to assess how much of the variation in the outcome measures could be explained by other unobserved state factors.

First, all study covariates and independent variables were evaluated through univariate regression analyses in order to determine unadjusted associations between the study outcome and covariates. Second, a full multivariable regression model was fit with covariates and independent variables. Odds ratios, 95% confidence intervals, and p-values were generated for regression analyses. Two-sided p-values < 0.05 were considered as statistically significant. All statistical analyses were performed using SAS version 9.4© (SAS Institute, Cary, NC, USA). An Internal Review Board (IRB) protocol was submitted and approved by the Indiana University IRB in November 2015 (Protocol #1510641672).

Limitations

To our knowledge, this study is among the first to examine the association between state NP SOP regulations and both time spent in patient care and delivery of preventive care within NP practice. However, several notable limitations should be discussed. First, this study uses a cross-sectional research design that examines NP practice patterns within one year. Cross-sectional designs allow researchers to study a population at a specific point in time, but do not allow causal inference (Stange, 2014). Therefore, this research design is less useful in assessing regulatory effects on the NP workforce since regulatory or policy effects typically vary over time (Xue et al., 2016). Also, the time it takes for changes to SOP regulations to show notable effect on the health

workforce is not well documented. Although a longitudinal research design may allow for better understanding of the changing policy environment's effect on the NP workforce, cross-sectional research designs are helpful for exploratory analyses that generate hypotheses.

Further, potential non-response bias poses a limitation to generalizability of this data. Since missing survey responses may not be missing at random (Altman & Bland, 2007), there is potential for respondents to differ in meaningful ways from non-respondents (Berg, 2005). To reduce non-response bias, sample weights were developed by HRSA to account for sampling design and non-response making the data from the survey representative at the national level and at the state-level for the larger states. We used the jackknife replicate weights to facilitate variance estimation within our analyses.

Lastly, survey response bias is another potential limitation to this study. The NSSNP asked respondents to report on several practice characteristics such as panel size, annual income, and time spent in patient care. Although self-report bias presents a potential limitation to the research, these data represent the best available data.

Results

Descriptive Statistics

Table 3.2 provides descriptive statistics for the study sample (n=11,091). The study sample was primarily comprised of White (89.8 percent) females (92.7 percent), which is consistent with the composition of the NP workforce at the national level. The majority of NPs within the study sample were trained with a minimum of a master's degree (master's degree, 94.4 percent; doctoral degree, 6.4 percent). Additionally,

approximately 50 percent of NPs report working in an ambulatory care setting, 47.7 percent in primary care specialties, and 84.9 percent in urban communities.

Percent Time Spent Delivering Direct Patient Care

The greatest proportion of NPs reporting that greater than 85% of their time was spent delivering patient care was found in states with "Excellent" policy environments (55.3 percent). Figure 3.1 illustrates the mean percent of respondents reporting 85 percent or more of their time spent in direct patient care. The univariate regression analysis demonstrated that NPs in states with favorable, satisfactory, or limiting professional practice environments were less likely to report more than 85% of their time working in patient care as compared to those working in states with an excellent policy environment. Full results from the univariate regression analyses and descriptive statistics for the percent time spent delivering patient care are provided in table A.1 in the appendices.

Preventive Services Delivery

The descriptive statistics and results from the univariate regression analysis are presented in table A.2 within the appendices. The greatest proportion of NPs providing preventive care to "most of their patients" was found in restricted policy environments as measured by the NPPPI; however, there was no significant association between NP professional practice environment and the delivery of preventive care by NPs in the univariate (table A.2).

However, we did identify significant variations in the univariate regression analysis when evaluating the delivery of preventive care by various practice and demographic characteristics including gender, race, education, practice setting, specialty,

and practice location. Men were significantly less likely to report providing preventive care to their patients as compared to their female counterparts. Non-white NPs were significantly more likely to provide preventive care to more of their patients. NPs trained at the associates or baccalaureate level were significantly more likely to provide preventive services to more of their patients as compared to those trained at the master's level. NPs not working in a primary care specialty were significantly less likely to report providing preventive care to more of their patients. Lastly, NPs working in rural areas (large rural, small rural, or isolated) were significantly more likely to report providing preventive care to a greater number of their patients as compared to those working in urban communities.

Multivariable Regression Analyses

Percent time spent in patient care

Table 3.3 presents the results of the multivariable regression analyses. In regard to the policy environment, NPs working in states with "favorable" or "satisfactory" professional practice environments were less likely to report more than 85% of their time working in patient care as compared to those working in states with an excellent policy environment. However, our results do not indicate a significant relationship between the "limiting" and "restricted" policy categories for NP SOP compared to the excellent category. Other significant predictors of time spent in patient care were age, race, gender, years of experience, education, practice setting, and hours worked per week. Males had 1.18 the odds of working more than 85 percent of their time in direct patient care as compared to their female counterparts. Non-White NPs were significantly less likely to report at least 85 percent of their time in direct patient care as compared to

whites. NPs not working in an ambulatory care setting were significantly less likely to report more than 85 percent of their time working in patient care. In fact, those working in academic settings were less than half as likely to report working more than 85 percent of their time in patient care. Lastly, NPs trained at the doctoral level were significantly less likely to report working 85 percent or more of their time in patient care as compared to those trained at the master's level.

Preventive services

There was no association between NP professional practice environment and the delivery of preventive services by NPs in the multivariable regression analyses (table 3.3). However, gender, age, years of experience, practice setting, specialty, practice location, and income were found to be associated with the delivery of preventive services to a greater number of patients (see table 3.3 for full multivariable regression results). Men had .643 the odds of providing preventive care services to a greater number of patients as compared to their female counter parts. All age categories were more likely to provide preventive services to a greater number of patients as compared to NPs 60 years of age or older, except for the 40-44 years of age category. Furthermore, as NPs gain more experience it appears they becoming increasingly less likely to provide preventive services to a greater number of their patients. NPs not working in primary care or in ambulatory care settings were significantly less likely to provide preventive care services to a greater number of patients. Lastly, NPs working in isolated rural areas were more likely to provide preventive services to a greater number of their patients as compared to those working in urban areas.

Discussion

Our findings suggest that there is some association between NPs' time spent in direct patient care and NP professional practice environments. More specifically, the results show that a greater number of NPs report working a minimum of 85% of their time in direct patient care in states with "Excellent" NP professional practice environments compared to favorable or satisfactory environments, but not when compared to the limiting or restricted policy environments.

In this study, we measured NP SOP by categorizing states into five groups based on an overall index score which quantifies the professional practice environment for NPs in a given state. Although this approach may provide a survey of the landscape surrounding NP practice, it ignores specific policies that may be common factors in specific policy categories. For example, all 31 states that were classified as excellent or favorable policy environments permit NPs to receive reimbursement by 3rd party payers. No states in the restricted policy category permit NP reimbursement. However, one of the two states in the limiting policy category does in fact permit NP reimbursement by 3rd party payers. As such, deviations from our expected results (as policy environments become more restrictive larger affects would be observed) may be explained from specific policy variations within the NPPPI categories. For example, if the ability to reimburse for services provided is a policy that is associated with the outcome then using a categorical coding scheme that includes states with and without reimbursement privileges may lead to inappropriate conclusions.

Our findings begin to demonstrate a relationship between NP SOP and PCPs' division of work. Previous research has shown that states that offer NPs the greatest

practice authority have the largest supply and greatest growth within the NP workforce (Auerbach, 2000; Kuo et al., 2013; Reagan & Salsberry, 2013; Stange, 2014). Yet, the ability to meet the increasing demand for primary care may depend both on growing the total number of providers and on using these providers in more efficient ways that allow them to maximize their time delivering care to patients (Pauly, Naylor, & Weiner, 2014).

One recent study which evaluated the impact of NP SOP policies on primary care utilization suggested that changes to occupational regulations (i.e. scope-of-practice) may influence the division of work and the activities in which health care providers engage. No previous research has studied how occupational regulations affect the division of work. However, it is important to understand how changes to SOP regulations may influence allocation of time because it has the potential to change the dynamic of health care delivery and capacity of the health care system. For example, physicians may reduce the number of hours spent on patient care in response to public policies such as the adoption of policies that increases the number of NPs a physician is permitted to supervise (Garthwaite, 2012). Adoption of such policies may shift a physician's focus to more administration and supervision responsibilities as compared to providing direct patient care. Similarly, it is possible that changes to NP SOP regulations may influence the time NPs spend providing direct patient care. Future research is needed to continue to explore this relationship, such as studies examining the impact of individual policies such as 3rd party reimbursement regulations.

Additionally, our findings suggest an association between NPs level of education and the time spent in patient care and the delivery of preventive services. More specifically, results demonstrate that NPs with higher levels of education (doctorate

degrees) spend less time in patient care. Nursing schools across the country are experiencing faculty shortages (American Association of Colleges of Nursing, 2016). The majority of open faculty positions require or prefer applicants with a doctoral degree (American Association of Colleges of Nursing, 2015). Therefore, in order to match qualified or desirable candidates with these vacant faculty positions, emphasis has been placed on training nurses at the doctoral level in hopes of reducing the burden of the faculty shortage. In fact, IOM released a report in 2010 that identified eight recommendations for states trying to advance the nursing profession and contribute to the overall vision of a health system that is safe, effective, patient-centered, timely, efficient, and equitable (Institute of Medicine, 2011). One of these recommendations was to double the number of nurses with a doctorate-level degree by 2020 in hopes of easing the burden of the nursing faculty shortage (Institute of Medicine, 2011).

Tables and Figures

Figure 3.1. State policy categories as defined by the Nurse Practitioner Professional Policy Index, 2012

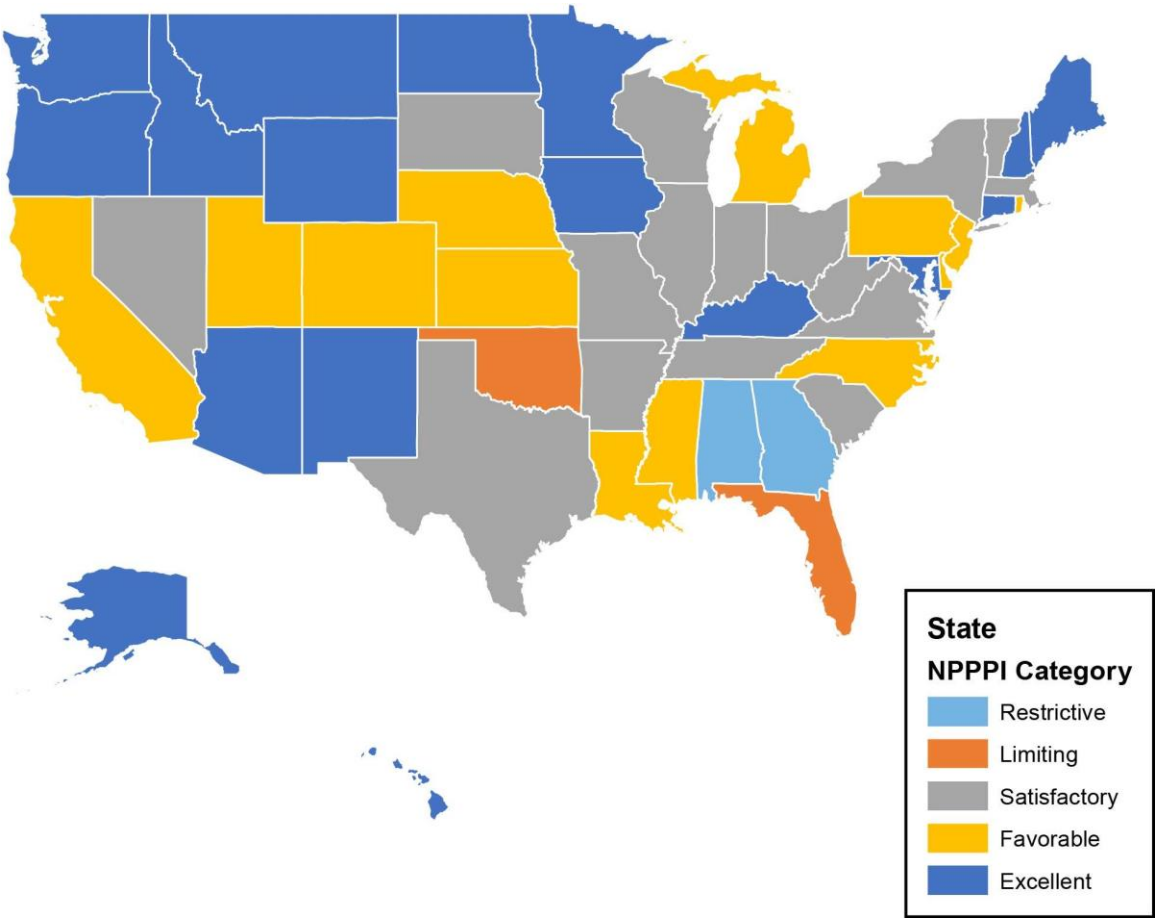


Table 3.1:

Nurse Practitioner Professional Practice Index Scores and Categories by State, 2012

State	Legal Status	Reimburse	Rx Authority	Total Score	Policy Category
New Hampshire	34	35	29	98	Excellent
Oregon	34	35	28	97	Excellent
Washington	34	35	28	97	Excellent
Wyoming	34	35	27	96	Excellent
Maine	32	35	28	95	Excellent
Maryland	33	35	27	95	Excellent
New Mexico	34	33.5	27	94.5	Excellent
Alaska	33	33	28	94	Excellent
Arizona	33	34	27	94	Excellent
Idaho	32	33.5	28	93.5	Excellent
Iowa	31	33.5	29	93.5	Excellent
Montana	33	33.5	27	93.5	Excellent
Connecticut	32	35	26	93	Excellent
Hawaii	32	32.5	28	92.5	Excellent
Kentucky	31	32.5	29	92.5	Excellent
Minnesota	31	34	27	92	Excellent
North Dakota	32	32.5	27	91.5	Excellent
California	27	35	26	88	Favorable
Colorado	31	30	27	88	Favorable
Nebraska	31	30	27	88	Favorable
New Jersey	27	33.5	27	87.5	Favorable
New York	27	33.5	27	87.5	Favorable
Delaware	30	30	27	87	Favorable
North Carolina	29	30	27	86	Favorable
Rhode Island	29	33	23	85	Favorable
Utah	27	30	28	85	Favorable
Kansas	29	28	27	84	Favorable
Louisiana	23	33	27	83	Favorable
Pennsylvania	24	35	24	83	Favorable
Michigan	26	30	26	82	Favorable
Mississippi	22	34	26	82	Favorable

Table 3.1:

Continued

State	Legal Status	Reimburse	Rx Authority	Total Score	Policy Category
Massachusetts	18	35	26	79	Satisfactory
South Dakota	24	29	25	78	Satisfactory
Texas	20	34.2	23	77.2	Satisfactory
District of Columbia	29	20	28	77	Satisfactory
South Carolina	20	33.5	23	76.5	Satisfactory
Tennessee	16	35	24	75	Satisfactory
Nevada	19	28.5	27	74.5	Satisfactory
Vermont	31	15	28	74	Satisfactory
Indiana	19	28.5	26	73.5	Satisfactory
Missouri	19	30	24	73	Satisfactory
Ohio	23	30	20	73	Satisfactory
Wisconsin	31	15	27	73	Satisfactory
Illinois	31	15	26	72	Satisfactory
West Virginia	17	35	20	72	Satisfactory
Arkansas	32	13	25	70	Satisfactory
Oklahoma	28	20	20	68	Limiting
Florida	22	28.5	13	63.5	Limiting
Virginia	17	15	27	59	Restrictive
Georgia	15	14	24	53	Restrictive
Alabama	21	20	9	50	Restrictive

Source: Nurse Practitioner Professional Practice Index, 2012

Table 3.2:

Sample Demographics

	Study Sample (n=11,091)	
	N	**%**
Gender		
Male	811	7.3%
Female	10,279	92.7%
Race		
White	9,957	89.8%
Non-White	1,134	10.2%
Age		
34 years of age or younger	1,521	13.7%
35-39 years of age	1,314	11.9%
40-44 years of age	1,376	12.4%
45-49 years or age	1,389	12.5%
50-54 years of age	1,680	15.1%
55-59 years of age	1,914	17.3%
60 years of age or older	1,897	17.1%
Years of Experience		
20+ Years	2,625	23.7%
19-15 Years	2,471	22.3%
14-10 Years	2,499	22.5%
9-5 Years	1,809	16.3%
≤ 4 Years	1,686	15.2%
Highest Degree		
Associates or Less	250	2.3%
Baccalaureate	371	3.3%
Masters	9,761	88.0%
Doctorate or higher	709	6.4%
Practice Setting		
Ambulatory	5,509	49.7%
Hospital	3,552	32.0%
Long term/elder care	506	4.6%
Public/community health	764	6.9%
Academic	760	6.9%
Marital Status		
Married	8,199	73.9%
Single	2,895	26.1%

Table 3.2:

Continued

	Study Sample (n=11,091)	
	N	**%**
Practice Location		
Urban	9,419	84.9%
Large Rural	971	8.8%
Small Rural	431	3.9%
Isolated	270	2.4%
Specialty		
Primary Care	5,291	47.7%
Internal Medicine Subspecialties	1,804	16.3%
Surgical Specialties	968	8.7%
Other	2,827	25.5%
No Specialty	201	1.8%
Hours per week		
0-8 Hours	165	1.5%
9-16 hours	390	3.5%
17-24 hours	993	9.0%
25-32 hours	1,433	12.9%
33-40 hours	5,426	48.9%
More than 40 hours	2,684	24.2%
Income (2011 Pre-Tax)		
Less than $50,000	1,339	12.1%
$50,001 to $87,500	4,233	38.1%
$87,501 to $120,000	4,533	40.9%
$120,001 to $250,000	985	8.9%

Source: Author's analysis of the National Sample Survey of Nurse Practitioners, 2012

Figure 3.2 Percentage of respondents with 85 percent or more time spent in patient care by NPPPI Policy Category, 2012

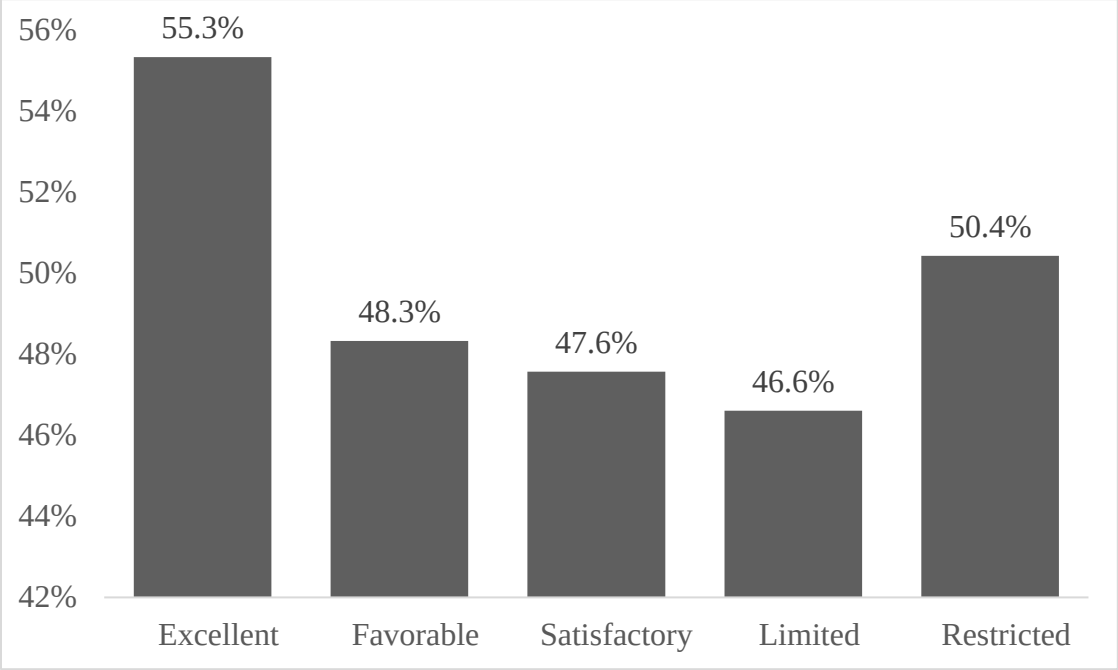


Figure 3.3. Quantity of patients receiving preventive services by NPPPI policy category, 2012

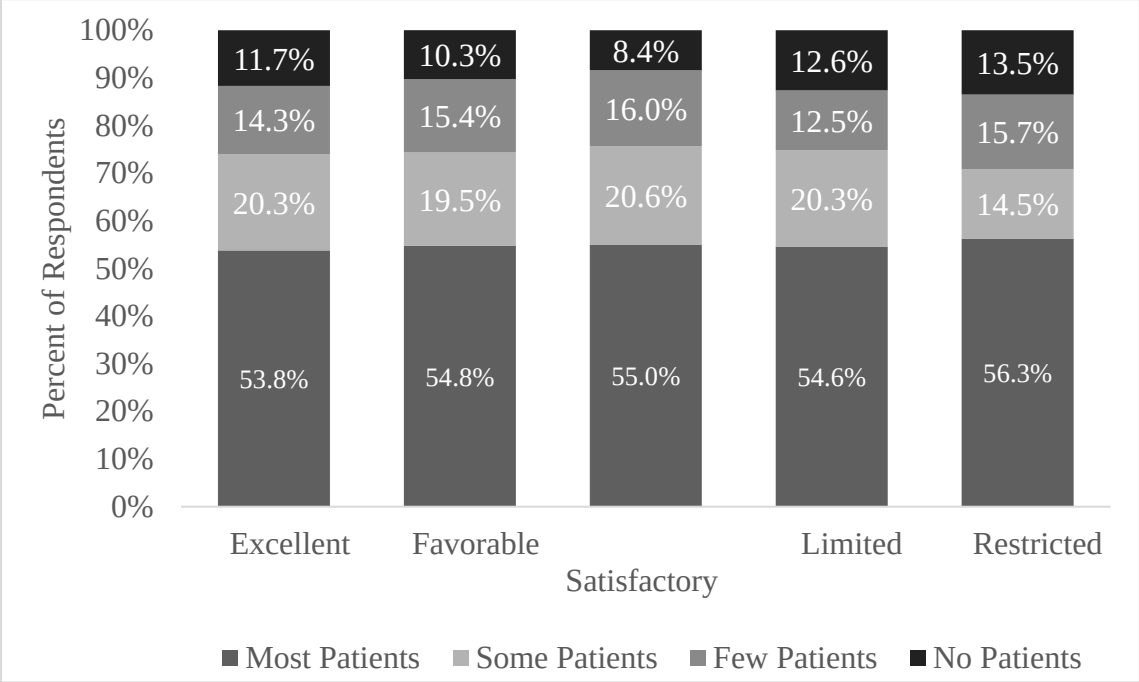


Table 3.3:

Multivariable Regression Results

	Percent Time Spent in Patient Care				Preventive Services			
		95% CL				95% CL		
	OR	Lower	Upper	P	OR	Lower	Upper	P
NPPPI Category								
Excellent (90-100)	Ref	Ref	Ref	Ref	Ref	Ref	Ref	Ref
Favorable (79-89)	0.79	0.69	0.90	< 0.001	1.11	0.90	1.37	0.33
Satisfactory (70-79)	0.79	0.69	0.92	< 0.001	1.11	0.72	1.71	0.64
Limited (60-69)	0.85	0.62	1.18	0.33	0.97	0.61	1.55	0.90
Restricted (0-59)	0.89	0.75	1.07	0.22	1.04	0.87	1.25	0.68
Gender								
Male	1.18	1.02	1.37	0.03	0.79	0.68	0.91	<.0001
Female	Ref	Ref	Ref	Ref	Ref	Ref	Ref	Ref
Race								
White	Ref	Ref	Ref	Ref	Ref	Ref	Ref	Ref
Non-White	0.68	0.67	0.93	<.0001	1.32	1.15	1.52	<.0001
Age								
≤ 34 years of age	0.86	0.73	1.02	0.08	1.41	1.17	1.68	<.0001
35-39 years of age	0.79	0.67	0.93	<.0001	1.38	1.16	1.63	<.0001
40-44 years of age	0.67	0.58	0.79	<.0001	1.14	0.97	1.34	0.11
45-49 years or age	0.68	0.59	0.79	<.0001	1.23	1.05	1.44	0.01
50-54 years of age	0.83	0.72	0.96	0.01	1.23	1.06	1.42	0.01
55-59 years of age	0.95	0.83	1.08	0.41	1.28	1.11	1.48	<.0001
≥ 60 years of age	Ref	Ref	Ref	Ref	Ref	Ref	Ref	Ref
Years of Experience								
20+ Years	0.82	0.70	0.97	0.02	0.75	0.64	0.89	<.0001
19-15 Years	0.77	0.66	0.90	<.0001	0.83	0.71	0.97	0.02
14-10 Years	0.80	0.69	0.92	<.0001	0.91	0.78	1.05	0.18
9-5 Years	0.95	0.82	1.09	0.45	0.98	0.84	1.14	0.78
≤ 4 Years	Ref	Ref	Ref	Ref	Ref	Ref	Ref	Ref
Highest Degree								
Associates or Less	0.94	0.72	1.23	0.65	1.45	1.06	1.99	0.02
Baccalaureate	1.02	0.81	1.28	0.87	1.02	0.80	1.30	0.85
Masters	Ref	Ref	Ref	Ref	Ref	Ref	Ref	Ref
Doctorate +	0.72	0.61	0.85	<.0001	1.13	0.96	1.33	0.15

Table 3.3:

Continued

	% Time Spent in Patient Care				Preventive Services			
	95% CL				95% CL			
	OR	Lower	Upper	P	OR	Lower	Upper	P
Practice Setting								
Ambulatory	Ref	Ref	Ref	Ref	Ref	Ref	Ref	Ref
Hospital	0.73	0.66	0.81	<.0001	0.65	0.59	0.73	<.0001
Long term care	0.75	0.62	0.90	<.0001	0.45	0.37	0.56	<.0001
Public health	0.82	0.70	0.96	0.02	0.92	0.77	1.09	0.32
Academic	0.45	0.38	0.54	<.0001	0.74	0.62	0.88	<.0001
Marital Status								
Married	Ref	Ref	Ref	Ref	Ref	Ref	Ref	Ref
Single	1.03	0.94	1.12	0.57	1.08	0.99	1.18	0.09
Practice Location								
Urban	Ref	Ref	Ref	Ref	Ref	Ref	Ref	Ref
Large Rural	1.11	0.96	1.28	0.15	0.97	0.83	1.12	0.64
Small Rural	1.20	0.98	1.47	0.08	1.18	0.95	1.48	0.14
Isolated	0.89	0.69	1.15	0.37	1.46	1.08	1.97	0.02
Specialty								
Primary Care	Ref	Ref	Ref	Ref	Ref	Ref	Ref	Ref
Internal Medicine	0.99	0.88	1.12	0.92	0.21	0.16	0.27	<.0001
Surgical Specialties	1.16	0.99	1.35	0.07	0.05	0.03	0.07	<.0001
Other	1.07	0.97	1.19	0.18	0.13	0.10	0.18	<.0001
No Specialty	0.51	0.37	0.71	<.0001	0.13	0.09	0.19	<.0001
Hours per week								
0-8 Hours	1.52	1.07	2.16	0.02	0.80	0.56	1.15	0.23
9-16 hours	1.63	1.26	2.12	<.0001	0.77	0.59	1.00	0.05
17-24 hours	1.23	1.04	1.45	0.02	1.00	0.85	1.19	0.99
25-32 hours	1.09	0.97	1.24	0.16	0.99	0.87	1.13	0.93
33-40 hours	Ref	Ref	Ref	Ref	Ref	Ref	Ref	Ref
More than 40 hours	0.90	0.82	0.99	0.04	1.19	1.07	1.33	<.0001
Income (2011 Pre Tax)								
Less than $50,000	1.06	0.89	1.27	0.50	0.74	0.62	0.89	<.0001
$50,001 to $87,500	1.09	0.99	1.20	0.07	0.92	0.83	1.01	0.07
$87,501 to $120,000	Ref	Ref	Ref	Ref	Ref	Ref	Ref	Ref
$120,001 to $250,000	0.91	0.79	1.05	0.21	0.87	0.75	1.02	0.09

Source: Author's analysis of the National Sample Survey of Nurse Practitioners, 2012

Chapter 4: Access to a Usual Source of Health Care: The Role of Nurse Practitioners and Changes to State Scope-of-Practice Regulations

Background

Access to health care—particularly access to a regular source of primary care—is important for the achievement of health equity in the United States (US Department of Health and Human Services, 2010). In fact, improving access to comprehensive, quality health care services is one of the goals of Healthy People 2020, America's guiding plan for health promotion and disease prevention (US Department of Health and Human Services, 2010).

One of the factors affecting access to health care and utilization is the geographic distribution of the workforce (Hall, Lemak, Steingraber, & Schaffer, 2008). Unfortunately, a shortage and inequitable distribution of primary care physicians hinders access to care for many people within the U.S. (Dussault & Franceschini, 2006). The shortage of primary care physicians in the U.S. is expected to continue to worsen over the next 10 years as the population grows and ages and with ongoing changes to the highly-politicized health care system. Implementation of the Affordable Care Act is expected to continue to worsen the primary care physician shortage by as much as 43 percent between 2013 and 2025; provider shortage implications from the new administration's forthcoming health care policy changes are yet to be determined. The exact number of additional primary care physicians needed to meet current patient demand in the U.S. ranges (Dall & West, 2015). Although the magnitude of the primary care physician shortage varies by source, researchers and policymakers do not dispute the existence of

the shortage and the potential negative impact it may have on access to health care (Bodenheimer & Pham, 2010; Kirch et al., 2012; Shipman & Sinsky, 2013).

Access to health care is generally more limited in rural and other non-urban areas than in urban areas of the U.S. as physicians in all specialties are more highly concentrated in urban settings. This discrepancy is less pronounced among the nurse practitioner workforce (Graves et al., 2016). As such, non-urban residents experience greater travel times and miles to access care from physicians than their urban counterparts (Probst, Laditka, Wang, & Johnson, 2007). In fact, as of January 2017, 64% of Primary Medical Health Professional Shortage Areas (HPSAs) were located in non-metropolitan areas (Health Resources and Services Administration, 2017).

Guidelines for HPSAs imply that travel in excess of 30 minutes for primary care is considered excessive (Health, 2006). Excessive travel times are associated with higher frequency of smoking, insufficient physical activity, short sleep, obesity, and generally poorer physical and mental health (Ding, Gebel, Phongsavan, Bauman, & Merom, 2014) in addition to missed appointments (Silver, Blustein, & Weitzman, 2012; Syed, Gerber, & Sharp, 2013; Yang, Zarr, Kass-Hout, Kourosh, & Kelly, 2006).

Furthermore, the provider shortage means many in the U.S. lack a "usual source of care" (USC), defined as a particular medical professional, doctor's office, clinic, health center, or other place where a person would usually go if sick or in need of advice about his or her health (Agency for Healthcare Research and Quality, 2009). The USC provider model is intended to improve access to care as well as facilitate more effective and efficient health care (Mayberry, Nicewander, Qin, & Ballard, 2006). As such, individuals having a USC are more likely to obtain preventive, primary, and specialty care services

than individuals without a USC. This is important because many Americans receive only half the recommended services for acute, preventive, or chronic disease care (Yarnall et al., 2009).

Despite the many benefits associated with having a USC, roughly 20% of adults in the U.S. lack a usual source of care (DeVoe, Tillotson, Lesko, Wallace, & Angier, 2011; Viera, Pathman, & Garrett, 2006). In 2014 (the most recent year for which data is available), an estimated 18.2 percent of the U.S. population had no USC provider (National Center for Health Statistics, 2013).

The primary care physician shortage may hinder appointment availability, which results in several problems; first, people forgo routine preventive care, and second, they seek care elsewhere, usually at more costly places such as emergency departments (EDs) (Ragin et al., 2005). In 2011, 21.6 percent of Medicaid enrollees without a USCs had half or more of their ambulatory visits in EDs compared to 8.1% for those with a USCs (Liaw, Petterson, Rabin, & Bazemore, 2014). Access to timely, primary care services outside the ED depends on numerous factors, including having USC (DeVoe, Fryer, Phillips, & Green, 2003). In fact, one study demonstrated that of those who reported ED use in the past year, roughly 34 percent also reported that availability of timely appointments was a barrier to medical care (Rust et al., 2008).

As the primary care physician shortage continues to worsen, policy-makers have focused on health workforce innovations and new models of care to promote access to care for Americans, particularly in health professional shortage areas (HPSAs). One such policy recommendation is to increase the SOP for primary care NPs to improve access to care (Dower et al., 2013; Naylor & Kurtzman, 2010; Pohl et al., 2010). NPs' advanced

training and clinical expertise allow them to provide a level of care equivalent to traditional physician care in many primary care settings (Dierick-van Daele et al., 2009), which is an important consideration as current primary care practice guidelines require more time than physicians typically have available. In fact, studies have concluded that health outcomes, treatment practices, and prescribing behaviors are similar between NPs and physicians. Patients of NPs also report higher levels of satisfaction with their care than with traditional physicians (Fanta et al., 2006; Lenz et al., 2004; Litaker et al., 2003; Mundinger et al., 2000; Pinkerton & Bush, 2000; Varughese et al., 2006). Several studies have reinforced this trend, finding that NPs outperform physicians on measures related to patient follow-up, time spent with patients, and screening, assessment, and counseling services.

Additionally, the supply of NPs continues to grow; there is a projected 30% increase in primary care NPs from 55,400 in 2010 to 72,100 in 2020 (National Center for Health Workforce Analysis, 2013). This growth, combined with an increasing supply of other advanced practice providers such as physician assistants (PAs), may substantially alleviate the projected shortage of full-time equivalent physicians from 20,400 to 6,400 if NPs and PA are effectively integrated into the primary care system (National Center for Health Workforce Analysis, 2013; Xue et al., 2016).

However, the ability of NPs to practice to the fullest extent of their education and training, as recommended by the Institute of Medicine, is moderated by a myriad of state SOP regulations. These SOP regulations delineate the clinical tasks and responsibilities that NPs are permitted to perform and under what circumstances they may perform such services (T. S. Bodenheimer & Smith, 2013). NP SOP regulations consist of three broad

domains, including: (1) legal standing and requirements for physician oversight/collaboration on diagnosis and treatment; (2) reimbursement policies (e.g. Medicaid reimbursement rates and requirements for private insurers); and (3) prescriptive authority (type of drugs, requirements for MD oversight) (Health Resources and Services Administration, 2004; E. S. Sekscenski et al., 1994). These SOP regulations are administered through state professional licensing boards, resulting in a wide variation of NP practice characteristics from state to state (Institute of Medicine, 2011). Unfortunately, the relationship between state-level SOP regulations and health care accessibility is not well documented.

Researchers have documented a link between higher levels of professional independence for NPs (i.e. less time spent on consultation with physicians) and improved appointment availability for patients (Traczynski & Udalova, 2013). However, availability does not alone equate to individuals actually accessing care as other factors contribute to the ability to use these available resources. In other words, accessibility relates to the ease of receiving care and considers variables such as transportation resources and travel times (Penchansky & Thomas, 1981). One study demonstrated that more lenient NP SOP regulations are associated with a more equitable distribution of health professions, thereby reducing patients' cost to travel to a provider (Traczynski & Udalova, 2013). This study examined only select policies and not on the impact of specific policies that may have theoretical relevance to the travel times and appointment availability. For example, Traczynski and Udalova evaluated independent practice authority and independent prescriptive authority. However, the ability to practice independently as a NP relies on several policies including medical record reviews,

collaborative agreement requirements, or the ability to be listed as the PCP on patient panels. Furthermore, it is still not well understood how these policies impact NPs ability to serve as USC providers, fostering an important preventive care element.

To our knowledge, no other study has empirically examined the impact of NP SOP policies related to reimbursement (i.e. independent billing privileges) and supervision (i.e. medical record review) on the following indicators of access to primary care: availability of providers (as defined by the designation of NPs as USC providers), availability of appointments, and patient travel times. As such, the goal of this study was to evaluate the impact of NP SOP policies related to reimbursement and supervision on primary care access as defined by USC provider type, appointment availability, and travel times. The study hypothesized that the removal of restrictions on NP reimbursement and supervision would result in increased appointment availability, reduced travel times, and increased prevalence of NPs as USC providers.

Study Data and Methods

The study utilized a difference-in-differences analysis of patient level data aggregated to the state level with intervention and comparisons states, a method widely used to identify the impact of policy changes (Buckley & Shang, 2003; French & Heagerty, 2008). We used patient-level data aggregated to state-level data for an 11 year period (2002-2013) to assess the 12 states that implemented changes to NP scope-of-practice (SOP) policies and the 35 comparison states (plus the District of Columbia) that did not implement such policies during this time period.

Data Sources

Data from the Medical Expenditure Panel Survey (MEPS) Full Year Consolidated Data Files from 2002-2013 were used for this study. MEPS is administered by the Agency for Healthcare Research and Quality (AHRQ) in order to collect information on patient experience, utilization, and health outcomes (Agency for Healthcare Research and Quality, 2009). MEPS is a two year dataset of households drawn from all members of the civilian non-institutionalized U.S. population (Agency for Healthcare Research and Quality, 2012). A state-year data file was created from the full year consolidated data files in order to study the impact of state-level policy changes on (1) USC provider type, (2) travel times, and (3) appointment availability.

AHRQ publishes public use files (PUF) of the MEPS Full Year Consolidated Data Files as well as the necessary documentation for researchers to study various measures of patient experience, utilization, and health outcomes. Geographic information is limited in these PUF files in order to protect individual level data. Accordingly, we contacted the AHRQ data center and requested access to the restricted geographic variable "state" in order to construct the longitudinal state-year data file. We merged state characteristics from the national Area Health Resource File (ARF) and the national Nurse Practitioner Professional Practice Index (NPPPI) with the MEPS 2002 to 2013 full year consolidated data files using respondents' state Federal Information Processing Standard (FIPS) codes corresponding to their state of residence. We then aggregated the data to the state level by year. Details on how this file was constructed as well as definitions for all covariates and outcomes are provided in the technical appendix.

An Internal Review Board (IRB) protocol was submitted and approved by the Indiana University IRB in November 2015 (Protocol #1510641672).

Outcome Measures

Usual Source of Care Provider Type

MEPS respondents are asked to complete a series of questions that allow researchers to describe the USC provider type. The variable "USC provider type" documents the type of medical professional that a patient reports as their USC provider. USC type is a categorical variable with 23 possible values as the physician's category is further stratified by sub-specialty. The USC variable is constructed from several questions within the Access to Care (AC) supplement including: *"Is [PROVIDER] a nurse, nurse practitioner, physician's assistant, midwife, or some other kind of person?"* The variable used for analysis is measured at the state level as the proportion of USC providers that are nurse practitioners and is represented as a continuous measure with a value between 0 and 1.

Travel Time to Usual Source of Care

The variable "travel time" was originally captured in the MEPS by asking respondents, *"How long does it take you to get to your USC provider?"* The variable is reported as a 6-level categorical variable where a value of 1 indicates "Less than 15 Minutes" and a value 6 indicates "More than 120 Minutes." As a part of the HPSA designation process, HRSA defines "excessive travel times" as longer than 30 minutes. Therefore, the research team dichotomized the categorical variable into two levels (1="30 minutes or less", 0= "more than 30 minutes"). This measure was then calculated as a

proportion of individuals reporting travel times of 30 minutes or less to their USC provider. This variable is a continuous measure with a value between 0 and 1.

Appointment Availability

We estimated appointment availability using patient responses to questions about the availability of an appointment when one is wanted. This information was gathered from the AC supplement by asking respondents, *"In the last 12 months, not counting the times you needed care right away, how often did you get an appointment for your health care at a doctor's office or clinic as soon as you thought you needed?"* We coded these responses as 1 if the patient reports "always" being able to get an appointment when wanted or when sick and 0 otherwise. This variable was evaluated as a continuous measure with a value between 0 and 1.

State-level Scope-of-practice Policies

We extracted NP SOP data from the NPPPI. Originally created in 1994 (Edward S. Sekscenski, Stephanie Sansom, Carol Bazell, Marla E. Salmon, & Fitzhugh Mullan, 1994), the NPPPI was the first attempt to create a comprehensive and objective system for documenting NP SOP policies by state. The NPPPI documents 26 NP SOP policies within three primary domains, including legal status, reimbursement, and prescriptive authority. The NPPPI currently contains data through 2015 on the 26 NP SOP policies for all 50 states and the District of Columbia. For this study, we focused on the two aspects of NPs' SOP that directly relate to NPs' ability to work as independent health care providers; these include reimbursement and supervision.

Reimbursement

In the U.S. healthcare system, public and private payers have authority to determine what services NPs are paid for, their payment rates, whether NPs are designated as primary care providers and assigned their own patient panels, and whether NPs can be reimbursed directly. Restrictive SOP regulations, in conjunction with strict payer policies, reportedly limit NPs to working as employees of physician practices or hospitals rather than independently. Given such payer restrictions, NP services are often provided as "incident-to" a physician's services, a billing arrangement that allows billing for NP care delivery under a physician's name. As such, the inability to be legally listed on a patient panel as a primary care provider may limit NPs' likelihood to serve as USC providers by restricting third party payer reimbursements. Therefore, we defined "reimbursement" in this study as the legal right to be listed on panels as a primary care provider.

Supervision

Another important component of NP SOP is the level of professional independence granted to NPs, which is commonly discussed in terms of their relationship with physicians. Supervision for NPs translates to more time spent on administrative tasks such as consultation between physicians for tasks such as medical record reviews and co-signatures. Therefore, for this study, we defined "supervision" as any requirement to have medical records reviewed by physicians.

Three states were excluded from the final analysis due to incomplete data for all 11 years included in the study. Therefore, 47 states and the District of Columbia were included in the final analysis, resulting in a total of 523 state-year observations from

2002-2013. Of the 48 states included in the study, 12 states implemented changes related to reimbursement (the provision that allows NPs to legally be listed on a panel of patients as the PCP) and/or supervision (the legal requirement for medical record review by physicians). Of these 12 states, eight states adopted legislation to allow NPs to legally be listed on a patient panel as a PCP (reimbursement); one of these states also adopted policies that eliminated the requirement for medical record review by physicians. The other four states implemented policies that removed the medical record review requirements (supervision) but not the legal right to be listed on a patient panel as a PCP (table 4.1, figure 4.1, and figure 4.2).

Statistical Analysis

We modeled the effect of implementation of reimbursement and supervision policies on the proportion of USCs that are NPs, travel times to USC providers, and appointment availability using a two-way fixed effects approach. The two-way fixed effects model includes both state and year fixed effects and is a generalized approach to difference-in-differences modeling (Wooldridge, 2010). These models included relevant time varying covariates that are described in detail below. The supervision and reimbursement policy variables were lagged one year to ensure that the policies had been completely implemented and to allow sufficient time for these policies to take effect.

While one state made changes to both reimbursement and supervision policies within the study period, the changes to these policies were separated by at least seven years. Since the policy changes were not made simultaneously, it is possible to assess the impact of each policy change separately. Simultaneous policy changes would have required an additional grouping.

State-level dummy variables controlled for all state-specific factors that were potentially correlated with access to care and were largely time invariant, such as a state's political climate, poverty level, population over age 65, uninsured, unemployment, median household income, percent urban population, percent white, and the population to provider ratio for NPs, PAs and physicians. Recognizing that the state-year observations are aggregated from multiple samples of the MEPS survey, the research team included covariates derived from the samples in each state that vary over time (percent male, age, insurance coverage, income, white, Hispanic, health status).

A dummy variable for each year was also included in the model to control for unobserved factors that vary from year to year in all states that could have some bearing on the outcome measures. We conducted all analyses using SAS Statistical Software®, version 9.4 with statistical significance reported at the .05 level. Additional details regarding the model construction, regression specifications, and software implementation is provided in the technical appendix.

Study Limitations

The findings of this study are subject to several limitations. First, the Full Year Consolidated Data File used in this study has been available since 1996, but the AC supplement has only been available since 2002. Therefore, we limited the study data to the years 2002-2013. The household survey, which is used to construct the full year consolidated data file, is also limited in that much of the data collected is self-reported. As such, the data are subject to possible errors that arise from self-report bias. As a result, visits to non-physician providers, such as NPs and PAs, are likely to be underreported (Morgan, Strand, Ostbye, & Albanese, 2007). This phenomenon may arise as a result of

lack of awareness of an individual's USC provider type. However, if the care provided by non-physicians is underreported it is reasonable to conclude that data analyzed and the illustrated effects in this study are conservative due to the potential of underreporting.

Furthermore, the effect of new or changing policies is not immediate. The SOP policies used in the study were documented by the time in which the policies were actually adopted. However, there may have been additional time required before any measurable change to the outcomes was noticeable. As such, the primary models used a one year lag of the NP SOP variables to control for this lag in policy implementation. We performed a sensitivity analysis by using a two year lag of the policy variable to determine if greater effects were found when allowing for additional time for changes to be realized in the health system.

This study relies on an observational research design and the use of secondary data to evaluate the impact of implementation NP SOP policies on various measures of health care delivery. Observational studies are commonly used to evaluate the changes in outcomes associated with health care policy implementation (Dimick & Ryan, 2014). However, an important limitation in using observational studies in this context is the need to control for background changes in outcomes that occur with time. The two-way fixed effect method as a generalized approach to difference-in-difference is an appropriate method to address this problem (Ryan, Burgess, & Dimick, 2015).

It is important to note that any assessment of causality in a nonrandomized study relies on assumptions about statistical models and their specification that must be guided by subject-matter knowledge (Hernan, Hernandez-Diaz, Werler, & Mitchell, 2002; Robins, 2001). Observational studies typically have additional concerns of internal

validity due to threats of unobserved confounding factors that were not addressed during the research design process. To improve internal validity, we included control outcomes in this study as a strategy for detecting section bias and reducing the probability of reporting of spurious relationships. More details on how the assessment of internal validity was conduct is provided in Appendix B.

Lastly, there are a myriad of occupational regulations which govern NP practice. This dissertation only examines only two policies within the NP SOP domains of reimbursement and legal status. We recognize that these two policies do not represent the full scope of policies regulating NP professional practice; they were selected because they represent two specific and quantifiable policies that have experience significant change across the states during the study period.

Study Findings

Table 4.2 presents the descriptive statistics for the study panel data representing 553 state-year observations. Over the study period (2002-2013), NPs comprised 1.62 percent of all USC providers in states without supervision restrictions (meaning no provisions for mandatory medical record review) whereas NPs comprised only 1.2 percent of all USC providers in states that did have such supervisory provisions. The same trend is true for reimbursement policies; a greater percentage (1.7%) of USC providers are reported to be NPs in states that do allow NPs to be listed on a patient panel as compared to states that do not provide NPs with this right (1.1%). With respect to travel times, a greater percentage of individuals report travel times of 30 minutes or less to their USC providers in states that do not require medical record reviews (90.1%) for NPs as compared to states that do mandate medical record reviews (88.9%).

Descriptive Statistics and Trends

On average across all states, the proportion of USC providers who are NPs increased from 0.7% in 2002 to 3.2% in 2013 (a 2.5% increase). Throughout the study period, the percentage of USC providers who are NPs was on average 0.4% and 0.5% higher in states who did not require mandatory medical record review or permitted NPs to be listed on patient panels, respectively. (See figure 4.3)

The percentage of individuals reporting travel times of 30 minutes or less to their USC provider increased from 88.9% in 2002 to 91.2% in 2013 (a 2.3% increase). Throughout the study period, the proportion of the sample population reporting travel times of 30 minutes or less was on average 1.2% higher in states who did not require mandatory medical record reviews. However, the proportion of the sample population reporting travel times of 30 minutes or less was approximately the same (0.22% lower) in states that permitted NPs to be listed on patient panels. (See Figure 4.4.) Lastly, the proportion of the sample population reporting "always" being able to schedule an appointment with their USC when they wanted increased from 50.1% in 2002 to 54.1% in 2013. However, this proportion did not vary greatly between states that have adopted or not adopted either of the SOP policies being examined (see Figure 4.5).

Effects of Scope-of-practice Policies on Study Outcomes

In our fully adjusted multivariable models, neither the absence of mandatory medical record review policies (supervision) nor the legal right for NPs to be listed on patient panels as a PCP (reimbursement) were associated with statistically significant increases in the proportion of USC providers that are NPs, travel times, or appointment availability (see table 4.3).

Sensitivity Analysis

Since the effect of health policy changes often takes several years to recognize, we conducted a sensitivity analysis that estimated models with a two-year lag time to determine if changes in SOP policies for NPs had any effect on the outcomes of interest two-year post implementation. The results of the sensitivity analysis are provided in table 4.4.

Among states that implemented policies that permitted NPs to be listed on patient panels as a PCP (reimbursement), policy implementation was significantly associated with a 2% increase in USC providers who were NPs. However, the absence of mandatory medical record review policies (supervision) was not significantly associated with increases in the proportion of USC providers that were NPs. Conversely, among states that removed mandatory medical record review policies, policy implementation was significantly associated with a 3.9% increases in the proportion of individuals who report travel times of 30 minutes or less to their USC provider. There was no significant association between reimbursement policies and travel times. Lastly, in our multivariable fully adjusted models with two-year policy lags, neither the absence of mandatory medical record review policies (supervision) nor the legal right for NPs to be listed on patient panels as a PCP (reimbursement) were significantly associated increases in appointment availability (see table 4.3).

Discussion

Our findings suggest that implementation of reimbursement policies affected NPs' role as a usual source of care provider and that the removal of supervision policies affected individuals' travel times to their USC provider.

Usual Source of Care

Research has shown that patients typically value the ability to receive health care services, specifically primary care services, and specifically from a USC provider (regardless of provider type (Cassidy, 2012). Furthermore, several research studies have demonstrated that patients have reported higher levels of satisfaction with care provided by NPs rather than physicians (Fanta et al., 2006; Lenz et al., 2004; Litaker et al., 2003; Mundinger et al., 2000; Pinkerton & Bush, 2000; Varughese et al., 2006). Additionally, increased scope-of-practice for NPs is likely to result in greater acceptance by both physicians and the general public. (See figure B.1.)

According to our findings, NPs continue to comprise an increasing proportion of the USC workforce. Also, we found that states that do not have mandatory medical record review requirements have a greater proportion of USC providers that are NPs compared to states that do not have these requirements. This is also true for states that allow NPs to be listed on patient panels as primary care providers.

A key finding of this research is that the removal of some supervision requirements effects NPs' role as a USC provider. This finding is consistent with previous research. One study that estimated NP care from a 5 percent national sample of Medicare beneficiaries found that there was a 2.5-fold difference in the odds of having an NP as a primary care provider for Medicaid patients between the states that were most and least restrictive states[3] in regard to NP SOP policies.

[3] State regulations for this study were classified into three levels: allowing independent practice and prescription authority; allowing independent practice but requiring supervision for prescriptions; and requiring physician supervision for practice and prescriptions.

The U.S. continues to face a primary care workforce shortage as a result of a growing (and aging) population, increasing rates of chronic illness, and a decrease in the uninsured rate (Bodenheimer et al., 2009; Bodenheimer & Smith, 2013). This "demand-capacity mismatch" in primary care is further illustrated by only 37% (287,000) of U.S. physicians practicing primary care even though 56% of visits to physicians' offices are for primary care services (Bureau of Health Professions, 2008). Furthermore, the primary care physician workforce is only projected to grow 8% between 2010 and 2020 (National Center for Health Workforce Analysis, 2013). On the other hand, the supply of NPs and PAs working in primary care is expected to grow at a much faster pace. There is a projected increase of 30% and 58% of NPs and PAs working in primary care, respectively (National Center for Health Workforce Analysis, 2013). However, it is unclear whether this growth will be sufficient to close the gap between the capacity and demand for primary care services (Bodenheimer et al., 2009).

Furthermore, favorable relationships between NPs and physicians is a significant predictor of whether NPs are satisfied with their jobs or have intent to leave (Poghosyan, Liu, Shang, & D'Aunno, 2017). Our study demonstrates that among states who removed mandatory medical record review requirements, policy implementation was associated with a greater proportion of individuals receiving USC from an NP. This finding suggests that adopting policies that limit supervision restrictions on NP professional practice and that are consistent with education and training may promote NPs working in primary care as USC providers.

Travel Times

State-level SOP policies that regulate NP professional practice commonly define the relationship between NPs and physicians. In many states, NPs are required to have direct supervision or collaborative agreement with a physician in order to practice. The precise requirements for these supervision provisions vary by state but commonly include: (1) the driving distance allowable between NPs and supervising physicians, (2) the number of NPs a physician may supervise, and (3) to what extent electronic communication is allowable as a mechanism for supervision.

NPs practicing in states with strict NP supervision policies are limited in the geographic distance in which they may practice away from a supervising physician. For example, in Texas, NPs are required to have direct supervision by physicians and in some cases physicians are required to physically sign NP charts in order to receive reimbursements; conversely in Washington state NPs are not tethered to a physician by these requirements, which means they do not necessarily need to be in close geographic proximity to physicians in order to serve as a USC provider. This may result in a greater geographic spread/distribution of providers that ultimately reduces travel times to USC providers, especially for those living in rural or low-income communities.

Our findings suggest that implementation of reimbursement policies affected individuals' travel times to their USC. We found that among states who implemented policies that allowed NPs the legal right to be listed on patient panels (reimbursement), policy implementation was associated with shorter travel times as measured by the proportion of individuals with travel times of 30 minutes or less to their USC provider.

This key finding is consistent with other studies that have concluded that the spread or geographic distribution of health professionals is influenced by NP SOP.

Traczynski and Udalova's difference-in-differences approach in their analysis of MEPS Full Year Consolidated Data Files (1996-2011) demonstrated an association between adoption of NP independence and decreasing travel costs (Traczynski & Udalova, 2013). In this particular study, NP independence was defined as the absence of all provisions that require any level of supervision or collaboration from a physician. Also, travel cost was measured by evaluating the level of difficulty individuals report with traveling to their health care provider. Although our analysis does not directly measure NP independence, the reimbursement and medical record review requirements are direct implications for NP independence. Traczynski and Udalova ultimately concluded that removal of policies requiring physician oversight for NP practice was associated with decreasing travel costs if providers relocate within rural and urban areas (Traczynski & Udalova, 2013). Our study complements these previous findings by demonstrating that implementation of polices providing NPs the legal right to be listed on patient panels (for the purpose of reimbursement) is significantly associated with decreases in travel times for patients.

Appointment Availability

We found no evidence to support the assertion that supervision or reimbursement policies for NP professional practice effect appointment availability. It is reasonable to expect changes in appointment availability as a result of changes to the required time spent on supervision and consultation between physicians and NPs that commonly accompanies NP SOP policies. In the study conducted by Traczynski and Udalova, there

was also no evidence of increased appointment availability one to four years after adoption of full independence for NPs (Traczynski & Udalova, 2013). However, their study included two measures of appointment availability[4]. The study did find that adoption of full independence was significantly associated with increased appointment availability for patients when they were sick (Traczynski & Udalova, 2013). This finding may indicative of the primary care system's ability to cope with unexpected or unplanned events.

Both of these studies use measure for appointment availability that are self-reported and subject to response bias. Implementation of a more accurate measure of appointment availability such as the difference in calendar days between a patient's initial appointment request and the date of the first available appointment (Tipirneni et al., 2016). Unfortunately, these data may provide more accurate measurement of appointment availability, they are not readily available and would require additional data collection.

Policy Implementation

The effect of new or changing health policies is not immediate. Some period of time must pass before any measurable change to the health system can be realized. As such, our primary model used a one year lag to account for the time for policy implementation. However, our primary analysis that accounted for a one year lag found no significant results between policy implementation and appointment availability,

[4] The first measure of appointment availability was consistent with the operational definition used in our study (Availability of an appointment when one is wanted). The second measure of appointment availability was measured as the ability to "always" get an appointment when the patient was sick. These measures were coded 1 if the patient reported "always" being able to get an appointment when wanted or when sick and 0 otherwise.

reduced travel times, and increased prevalence of NPs as USC providers. Our subsequent sensitivity analyses included a two year lag to determine if greater effects were found when allowing for additional time for changes to be realized in the health system. In these analyses, we found significant associations between implementation of NP SOP policies and reduced travel times as well as increased prevalence of NPs as USC providers. This finding is important and illustrates the time required to accurately evaluate the effect of new policies on the health system.

Future Research

There is a growing body of literature reinforcing the need for new and innovative models for care delivery that fully leverage advanced practice providers and existing resources in order to significantly increase the overall capacity of the primary care system (T. S. Bodenheimer & Smith, 2013; Cassidy, 2012; Institute of Medicine, 2011). One such strategy is to expand the role of non-physician providers such as nurse practitioners. However, research is limited and does not consistently demonstrate the outcomes of NP SOP reform (Xue et al., 2016).

Our study represents one of few studies that have sought to examine the impact of specific NP SOP policies on appointment availability, travel times, and increased prevalence of NPs as USC providers in order to better understand the role these policies play in NP professional practice. Furthermore, the majority of current literature utilizes cross-sectional research designs that greatly impede the ability to establish causal inference, particularly for nonrandomized studies. Only a few studies have implemented robust research methods for evaluating changes in health care policy such as the difference-in-difference approach used in our study. Therefore, future research must seek

robust longitudinal data sets such as the MEPS as well as longitudinal measures of NP SOP which allow the use of these more robust research designs for evaluating changes in health care policy. Future research may also benefit from the implementation of more precise measures (i.e. travel times, appointment availability) in order to reduce the presence of response bias in these observational research studies.

Conclusion

In conclusion, allowing NPs the legal right to be listed on patient panels as primary care providers appears to reduce travel times to USC providers. The geographic distribution of the workforce that delivers these services is among the critical factors that play a role in health care access (A. G. Hall et al., 2008). The study findings also suggest that removing policies that require medical record reviews (supervision) may improve the geographic spread of USC providers, resulting in decreased travel times.

Tables and Figures

Table 4.1:

Timing of implementation and key provisions for policies related NP scope-of-practice

	Reimbursement		Supervision	
State	Changed	Year	Changed	Year
Louisiana	Yes	2004	-	-
Minnesota	Yes	2005	-	-
Mississippi	Yes	2005	-	-
New Hampshire	Yes	2005	-	-
South Carolina	Yes	2005	-	-
West Virginia	Yes	2002	-	-
Wyoming	Yes	2005	-	-
Hawaii	Yes	2009	Yes	2002
Alabama			Yes	2006
Connecticut			Yes	2006
Georgia			Yes	2012
Maryland			Yes	2010

Notes: States not implementing changes to medical record review requirements or legal right to be listed on patient panels during our study period: Arizona, Arkansas, California, Colorado, Delaware, District of Columbia, Florida, Idaho, Illinois, Indiana, Iowa, Kansas, Kentucky, Maine, Massachusetts, Michigan, Missouri, Montana, Nebraska, Nevada, New Jersey, New Mexico, New York, North Carolina, Ohio, Oklahoma, Oregon, Pennsylvania, Rhode Island, Tennessee, Texas, Utah, Vermont, Virginia, Washington, and Wisconsin. Three states (North Dakota, South Dakota, and Alaska) were removed from the analysis due to incomplete data across all study years.

Figure 4.1. Change in medical record review policies throughout the study period (2002-2013).

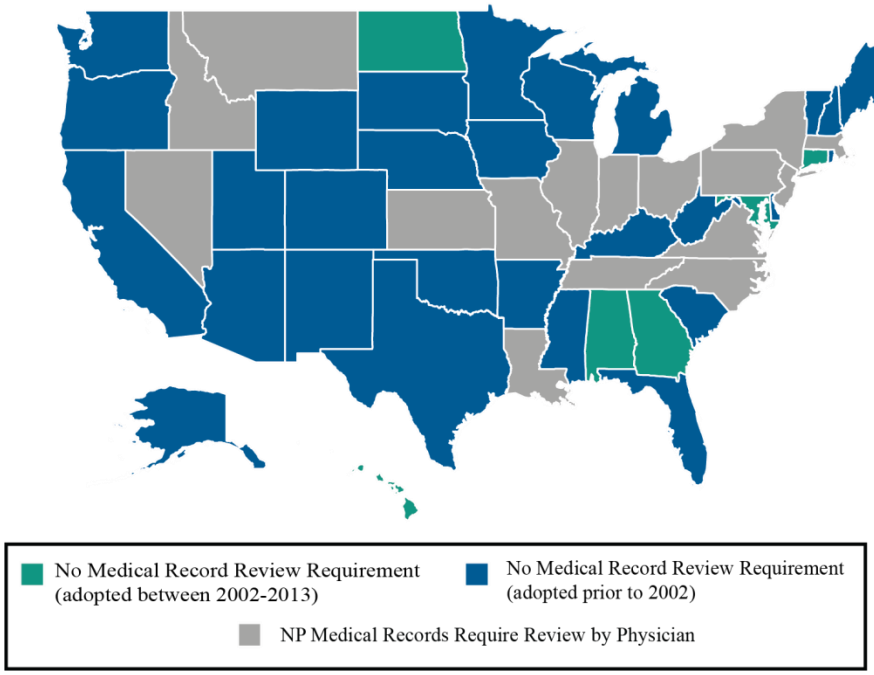


Figure 4.2. Change in reimbursement policy (right to be listed on a patient panel) throughout the study period (2002-2013).

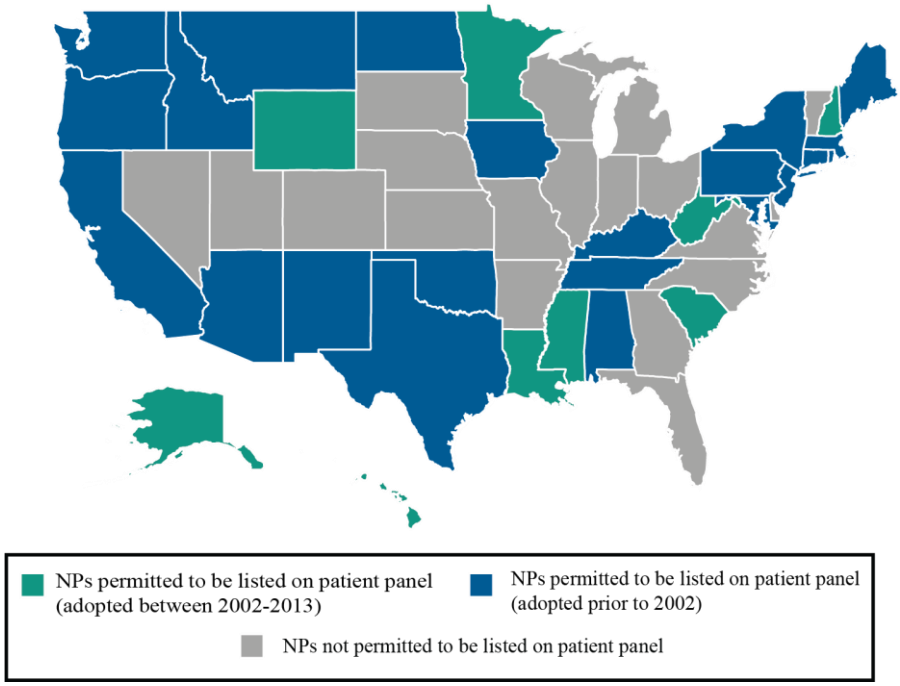


Table 4.2:

Descriptive Statistics for State Panel Data: United States, 2002-2013

	Mandatory Medical Record Review				NPs Have Legal Right to be Listed on Patient Panel as PCP			
	Intervention States (not required)		Comparison States (Required)		Intervention States (Allowed)		Comparison States (Not Allowed)	
Outcome Measures	Mean	SD	Mean	SD	Mean	SD	Mean	SD
USC - Nurse Practitioner	1.62%	0.03	1.18%	0.03	1.73%	0.04	1.10%	0.02
Travel Time	90.12%	0.07	88.91%	0.05	89.69%	0.06	89.69%	0.07
Appointment Availability	52.48%	0.10	52.73%	0.07	52.56%	0.09	52.58%	0.09
State Variables								
Poverty Rate	15.44%	0.03	15.01%	0.03	15.54%	0.03	14.95%	0.03
Share Over 65	14.01%	0.02	14.01%	0.01	14.11%	0.02	13.88%	0.02
Median Household Inc.	$51,651	$8,252	$52,162	$8,820	$52,461	$9,651	$50,986	$6,425
Unemployment Rate	7.23%	0.02	7.58%	0.02	7.48%	0.02	7.19%	0.02
Percent Urban Population	72.66%	0.16	77.12%	0.11	74.39%	0.16	74.07%	0.13
Uninsured Rate	18.98%	0.06	18.84%	0.05	18.99%	0.06	18.85%	0.05
PA per 100,000	3.19	1.62	2.95	1.25	3.21	1.58	2.97	1.38
PC MD per 100,000	27.83	9.56	28.34	6.75	29.56	10.69	25.93	3.82
Sample Characteristics								
Male	46.01%	0.05	44.67%	0.03	45.53%	0.05	45.54%	0.05
Age	36.89	4.52	36.12	3.18	36.46	3.93	36.82	4.32
Insurance Coverage	1.45	0.15	1.43	0.12	1.46	0.15	1.42	0.13
Income	1.80	0.25	1.80	0.20	1.81	0.26	1.79	0.20
White	75.21%	0.20	72.73%	0.15	73.54%	0.20	75.38%	0.16
Hispanic	16.04%	0.18	13.50%	0.11	17.22%	0.19	12.30%	0.12
Health Status- Good	87.81%	0.05	87.42%	0.04	87.23%	0.05	88.27%	0.04

Source: Authors analysis of MEPS data from 2002 to 2013 **Notes:** All variables and covariates are defined in appendix Table A.1

Table 4.3:

Estimated impact of nurse practitioner scope-of-practice policies on state-level measures of access to care (one year lag)

	Outcome 1: Usual Source of Care - Proportion NP		Outcome 2: Travel Times - Proportion < 30 min		Outcome 3: Appointment Available when Wanted	
	β	SE	β	SE	β	SE
Scope-of-practice Policies						
Legal Provider (Reimbursement)[a]	0.014	0.007	0.020	0.011	-0.022	0.017
Medical Record Review (Supervision)[b]	0.006	0.010	0.029	0.015	0.000	0.022
Independent Variables						
Male	-0.030	0.040	-0.171	0.061**	-0.050	0.093
Age	0.000	0.001	-0.002	0.001*	0.003	0.001**
Insurance Coverage	0.022	0.017	-0.047	0.026	0.088	0.039*
Income	0.020	0.010*	0.068	0.015**	-0.012	0.023
White	0.039	0.021	-0.076	0.032*	0.033	0.049
Hispanic	-0.062	0.024*	0.011	0.036	0.009	0.055
Health Status	-0.002	0.046	0.147	0.070*	0.187	0.106

Sources: Authors analysis of MEPS data from 2002 to 2013. **Notes:** Marginal effects are reported. Robust standard errors clustered at the state level. Independent variables are defined in detail in the technical appendix. [a] Medical record review is defined as state policy requiring any medical record review by a physician. [b] Legal provider is defined as state policy providing NPs' the legal right to be listed on a patient panel as a primary care provider. *p <0.05 **p <0.01

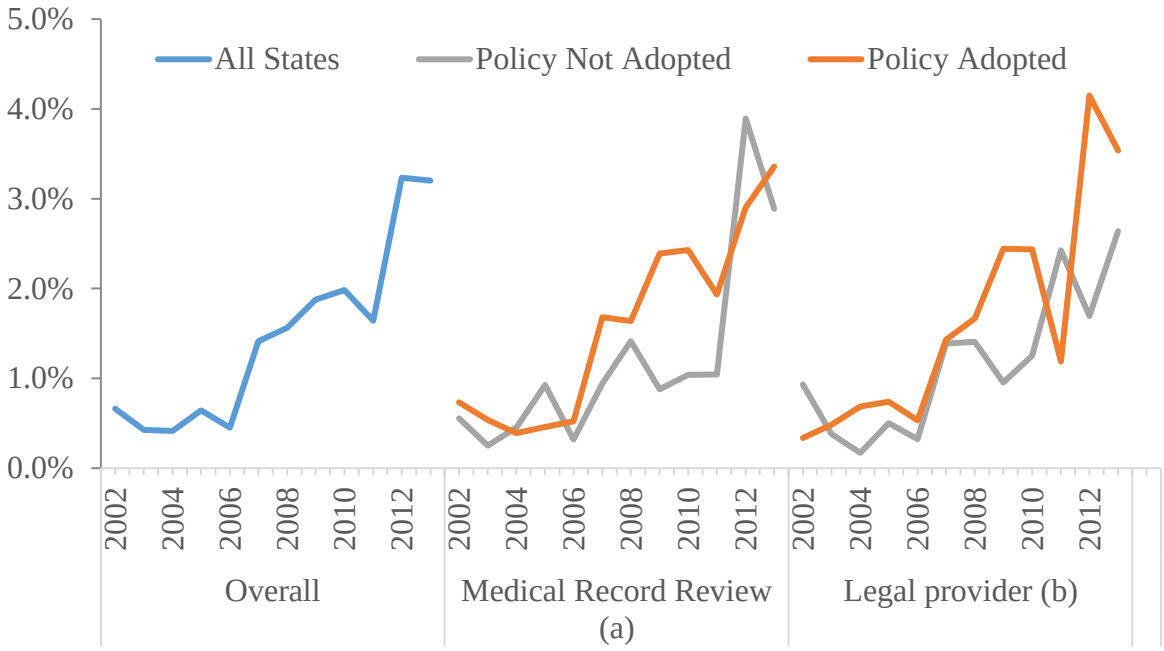
Table 4.4:

Estimated impact of nurse practitioner scope-of-practice policies on state-level measures of access to care (two year lag)

	Outcome 1: Usual Source of Care - Proportion NP		Outcome 2: Travel Times - Proportion < 30 min		Outcome 3: Appointment Available when Wanted	
	b (coefficient)	SE	b (coefficient)	SE	b (coefficient)	SE
Scope-of-practice Policies						
Legal Provider (Reimbursement)[a]	0.020**	0.008	0.016	0.011	0.005	0.018
Medical Record Review (Supervision)[b]	0.004	0.011	0.039*	0.016	0.012	0.026
Independent Variables						
Male	-0.024	0.043	-0.106	0.063	-0.107	0.099
Age	0.000	0.001	-0.002**	0.001	0.003	0.001*
Insurance	0.027	0.019	-0.028	0.027	0.084	0.042*
Income	0.022*	0.010	0.071**	0.015	-0.004	0.024
White	0.039	0.023	-0.065	0.033	0.049	0.052
Hispanic	-0.062*	0.026	0.005	0.037	0.010	0.058
Health Status	-0.013	0.051	0.034	0.074	0.091	0.116

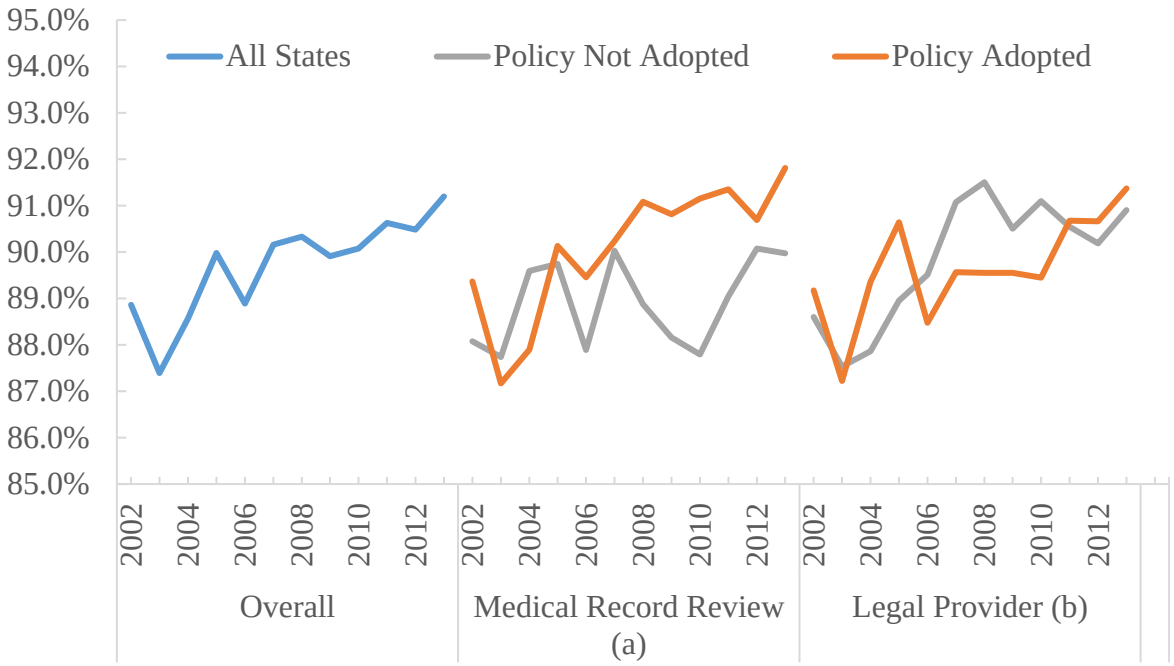
Sources: Authors analysis of MEPS data from 2002 to 2013. **Notes:** Marginal effects are reported. Robust standard errors clustered at the state level. Independent variables are defined in detail in the technical appendix. [a] Medical record review is defined as state policy requiring any medical record review by a physician. [b] Legal provider is defined as state policy providing NPs' the legal right to be listed on a patient panel as a primary care provider. *p <0.05 **p <0.01

*Figure 4.3. T*rends by policy category for the percentage of usual source of care providers that are NPs (2002-2013).



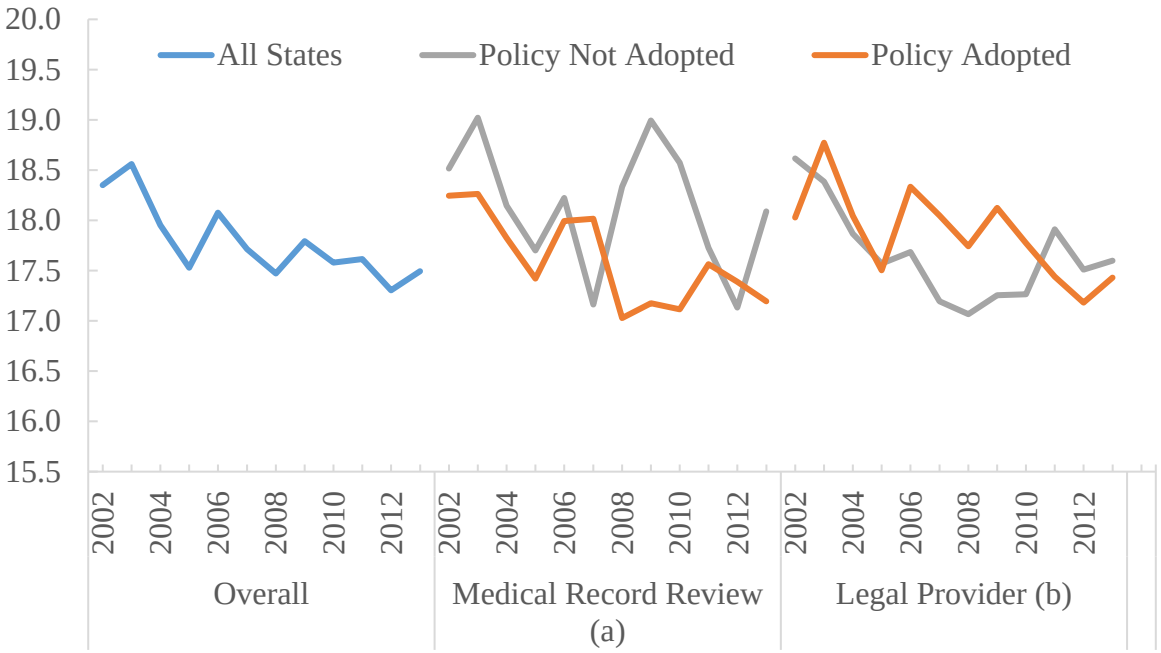
Sources: Author's analysis of MEPS data from 2002 to 2013. **Notes:** This figure depicts the trend in proportion of usual source of care providers that are reported to be NPs during the study period. (a) Medical record review is defined as state policy requiring any medical record review by a physician. (b) Legal provider is defined as state policy providing NPs' the legal right to be listed on a patient panel as a primary care provider.

Figure 4.4. Trends by policy category for travel time to a USC provider (2002-2013).



Sources: Author's analysis of MEPS data from 2002 to 2013. **Notes:** This figure depicts the trend in proportion of usual source of care providers that are reported to be NP during the study period. (a) Medical record review is defined as state policy requiring any medical record review by a physician. (b) Legal provider is defined as state policy providing NPs' the legal right to be listed on a patient panel as a primary care provider.

Figure 4.5. Trends by policy category for travel time to a USC provider (2002-2013).



Sources: Author's analysis of MEPS data from 2002 to 2013. **Notes:** This figure depicts the trend in proportion of usual source of care providers that are reported to be NPs during the study period. (a) Medical record review is defined as state policy requiring any medical record review by a physician. (b) Legal provider is defined as state policy providing NPs' the legal right to be listed on a patient panel as a primary care provider.

Chapter 5: Discussion, Policy Implications, and Future Direction

Overview

Although researchers continue to debate the magnitude of the primary care workforce shortage, there is widespread consensus regarding a discrepancy between the supply and demand of primary care providers. Indeed, "The health policy literature has been inundated with articles on the worsening shortage of primary care physicians" (Bodenheimer & Smith, 2013; Goldsmith, 2012; Green et al., 2013; Schwartz, 2012). Furthermore, the current PCP shortage in the United States is expected to worsen over the next 10 years as a result of increase demand on the primary care system from a growing (and aging) population, increased prevalence of chronic disease, and increased rate of health insurance among the population (Bodenheimer et al., 2009; Goldsmith, 2012; Green et al., 2013; Hofer et al., 2011; Mitka, 2007; Schwartz, 2012; Steinwald, 2008).

The worsening primary care workforce shortage is expected to disproportionately impact vulnerable populations and rural communities due to the inequitable distribution of the health workforce (Dussault & Franceschini, 2006; Rabinowitz, 1993). Numerous factors contribute to the maldistribution of health workforce, including lack of financial incentives and lack of professional and personal opportunities (Zaidi, 1986). The U.S. Department of Health and Human Services provides Health Professional Shortage Area (HPSA) designations to identify areas and population groups within the U.S. that are experiencing a shortage of health professionals. This program, established in 1964 under Section 330 of the Public Health Service Act (42 USCS § 254b) of the Social Security program, was developed to improve access to comprehensive primary care for underserved communities that have unmet health care needs. As of January 1, 2017,

43.2% of the U.S. population has documented unmet health care needs (2017).[5] Figure C.1 illustrates the percent of need met for each state. Additional data tables for the percent of need are provided in Appendix C.

As the primary care workforce shortage garners more and more attention, policy-makers and health care professionals continue to look for innovative health workforce and health care delivery models to improve primary care capacity and address the American's health care needs. One promising solution is to reform state scope-of-practice policies in order to expand the role of NPs so that they are able to practice in a manner consistent with their education and training (Cassidy, 2012).

Occupational regulations (including scope-of-practice policies) is a "states' right," but since the 1960s the federal government and various health professional organizations have taken an increased interest in health care workforce regulations and their effects on health care cost, access and quality (Weissert, 1996). These SOP regulations specify the legally permissible boundaries of practice for health care providers including the clinical tasks they may perform and under what provisions they may conduct these activities (Weissert, 1996). Some states have used this authority to enact SOP policies that prohibit certain professionals from practicing to the fullest extent of their training. Such policies not only fail to "provide for the general welfare of [the] people" (*Id*.), but also limit various aspects of health care delivery (Ku et al. 2015; Kuo et al. 2013; Spetz et al. 2013). For example, federally qualified health centers (FQHCs) located in states with the most restrictive policies regulating dental hygiene professional practice had 0.28 the odds

[5] The percent of need is computed by dividing the number of physicians available to serve the population of the area, group, or facility by the number of physicians that would be necessary to eliminate the primary care HPSA (based on a ratio of 3,500 to 1 (3,000 to 1 where high needs are indicated))

of delivering dental services as did those located in states with the most supportive SOP policies for dental hygienists (Maxey, Norwood, & Liu, 2016).

There is an ongoing debate about the effects of expansion of NP scope-of-practice. Those in opposition commonly cite concerns over patient safety whereas those in favor demonstrate that the SOP policies are not consistent with national education and training standards (Cassidy, 2012). Recently, the opposition argument was effectively dismissed by the U.S. Supreme Court in *North Carolina State Board of Dental Examiners v. Federal Trade Commission,* 135 S.Ct. 1101 (2015). In this case, the Federal Trade Commission (FTC) alleged that the North Carolina State Board of Dental Examiners (hereafter, Board) violated the FTC Act by systematically excluding "non-dentists," including dental hygienists, from providing teeth whitening services. While the Board attempted to justify its exclusionary policy by using the above argument—alleging that allowing "non-dentists" to provide oral health services would decrease the quality of care and cause public safety issues, the Court rejected this argument, pointing to "a wealth of evidence" that allowing "non-dentists" to provide these services posed no safety concerns.

The variation in NP SOP policies across the U.S. (previously discussed in Chapter 1) as well as the Supreme Court's opinion stated in *North Carolina State Board of Dental Examiners v. Federal Trade Commission* (135 S.Ct. 1101) further illustrate the IOM's assertion that, "what nurse practitioners are able to do once they graduate varies widely for reasons that are related not to their ability, education or training, or safety concerns, but to the political decisions of the state in which they work" (Institute of Medicine, 2011). As such, policy efforts to reform NP SOP policy have garnered a great deal of

support in recent years. However, policy decisions should be informed by evidence and robust research to increase their effectiveness. Consequently, evaluating the impact changes to these policies have on the cost and quality of health care and patients' access to care is critical for informing future policy and addressing health system priorities. The literature in this area is sparse and the impact of changes to these NP SOP polices are not well documented (Xue et al., 2016).

Policy Implications

Nurse Practitioner SOP Policies and Expanding Roles in Primary Care for NPs

One of the primary outcomes studied in this dissertation was the role of NPs as a USC provider. Descriptive data presented in this dissertation demonstrate that the percentage of USC providers who are NPs increased by 2.5% between 2002 and 2013. We also found that among states which implemented policies that permitted NPs to be listed on patient panels as a PCP (reimbursement), policy implementation was significantly associated with a 2% increase in USC providers who were NPs.

Researchers have focused primarily on the association of policies within the domains of legal status and prescriptive authority on NP practice and health care delivery (Xue et al., 2016). Only 2 out of the 15 studies identified in systematic review of the literature evaluated the relationship between reimbursement policies for NPs and health care delivery (Xue et al., 2016). However, practicing NPs report that payer policies have more of an impact than other NP SOP policies on their professional practice (Yee et al., 2013). For example, in Arkansas and Indiana, it is legally permissible for NPs to provide influenza swabs (Yee et al., 2013). However, in these states NPs are not recognized as primary care providers by traditional Medicaid, which prohibits them from billing

directly for these services (Yee et al., 2013). Due to these reimbursement restrictions for NPs, many NP services are provided as "incident-to" a physician's services. Incident-to billing is a special arrangement that allows billing for NP care delivered under a physician's license (Yee et al., 2013). Our findings demonstrate that payer policies (reimbursement) may impact, to some extent, the ability of NPs to serve as USC providers.

The most commonly discussed strategy focuses on the educational pipeline and aims to increase the number of physicians practicing in primary care (Bodenheimer et al., 2009). This may in fact be the most direct strategy, but increasing the number of primary care physicians requires years due to the length of time it takes to train one provider. For example, it takes approximately 11 years to train a family medicine physician. Educational pipeline strategies may present a long-term solution, but reforming SOP policies for advance practice providers such as NPs may provide some more immediate relieve to the primary care system. Our findings support this by demonstrating that NPs take on a more prominent role as USC providers when states implement policies to all NPs the right to be listed on patient panels as the primary care provider.

Geographic Distribution of Primary Care Workforce

Not only is the U.S. faced with a primary care workforce shortage, but the geographic distribution of these provides is skewed and disproportionately effects underserved communities. Graves and colleagues recently published results from a study that examined the role of geography and NP SOP on efforts to expand primary care system capacity (Graves et al., 2016). This observational cross-sectional study used commuter travel data from the U.S. Census Bureau and concluded that primary care NPs

and primary care PAs were relatively more distributed in rural areas and in full-practice[6] states. Graves et al, demonstrates an association between NP SOP policies and the geographic distribution of NPs, PAs, and physicians, but their study was not designed to produce causal estimates of the effects of SOP laws. In fact, they define SOP using the AANP method for categorizing NP professional practice environments. As such, the study findings are potentially less meaningful as it is impossible to identify which NP SOP policies within the three domains of NP practice are the mechanism for this observed relationship between NP SOP policies and geographic distribution.

Our study is consistent with and builds on the findings of Graves et al. We found that among states that removed mandatory medical record review policies (supervision), policy implementation was significantly associated with a 3.9% increase in the proportion of individuals who report travel times of 30 minutes or less to their USC provider.

Our findings support the conclusions of Graves et al., but also allow us to understand a potential mechanism for the geographic dispersion of primary care NPs. We studied specific supervision and reimbursement policies and their impact on travel times to USC providers. As such our findings indicate that policymakers looking to improve primary care system capacity through NP SOP reform may benefit more from addressing specific NP SOP policies such as medical record review policies instead of trying to immediately realize a "full practice" environment.

Time Spent in Direct Patient Care

Efforts to strengthen the primary care system require much more than simply training more providers; it requires a close examination of the capacity of providers to

[6] AANP definition of "full practice" is defined in Chapter 1.

deliver direct patient care. Studies have demonstrated that primary care physicians caring for a standard patient panel size of 2,500 individuals would require an additional 108.5 hours per week to meet national clinical care guidelines for their patients (Yarnall et al., 2003). In other words, the capacity of providers to meet clinical care guidelines is limited by other (ex: administrative) burdens. Similarly, our research demonstrates that NPs trained at the doctoral level spend significantly less time than masters-level NPs in providing patient care. As such, efforts that promote advanced education for NPs should consider this research and understand how these policies effect NP practice patterns.

Future Direction

Longitudinal Research Designs

There has been increased interest in health professional scope-of-practice policies and their impact on health care delivery in recent years. This is especially true in the case of nurse practitioner SOP policies. Researchers continue to attempt to answer the question, "How do changes to NP SOP impact health care delivery?" Since 2007, 17 research studies sought out to identify the effect of changes to NP SOP on measures of health care delivery. All of these studies were observational studies of which only 6 utilized a time-series research design.

A cross-sectional observational study looks at a snapshot of a population from a single point in time (Aschengrau & Seage, 2014). This research design allows researchers the opportunity to evaluate the relationship between an exposure and outcome prevalence in a defined population without regard to changes over time (Aschengrau & Seage, 2014). If the primary objective of the research is to establish causality, the most appropriate research design is a randomized experiment (Antonakis, Bendahan, Jacquart,

& Lalive, 2010). However, many times randomized research designs are not logistically feasible in health policy research due to logistical constraints such as time or cost. However, "correlation can mean causation" in observational research designs if some key design conditions are present and the appropriate statistical methods are used (Antonakis et al., 2010). To measure causal effects, three classic conditions must be met (Kenny, 1979). These are:

(1) x (cause) must precede y (effect) temporally;

(2) x must be reliably correlated with y (beyond chance); and

(3) the relationship between x and y must not be explained by other causes.

Longitudinal observational research studies are commonly used to evaluate the changes in outcomes associated with health care policy implementation (Dimick & Ryan, 2014). However, observational studies in health policy research that aim to determine the underlying mechanisms effecting change must control for secular trends (i.e. market trends over time) affecting outcomes (Dimick & Ryan, 2014). In other words, these research studies must remove potential confounding factors that may result in spurious relationships or findings in observational research designs. To address this limitation in the health policy NP SOP literature, researchers must access high quality longitudinal data that measures relevant outcomes expected to be effected by implementation of new NP scope-of-practice policies.

Longitudinal data on the NP workforce is hard to find. Several surveys and data source exist that are designed to collect information on health care access, cost, and quality. For example, the MEPS survey was designed to provide health services researchers a comprehensive dataset that allows for robust research on access, cost and

quality of health care services in the U.S. However, these datasets are limited in their information regarding NP practice and NP provided health care. The National Center for Health Workforce Analysis (NCHWA), recognizing the gap in data available to study the NP workforce, developed the NSSNP to collect data on education, training, employment, and practice patterns of the NP workforce. However, this survey was only conducted in 2012. Researchers looking to develop future research to further policy discussions surrounding health professional SOP must have access to robust longitudinal data that allows for the development of robust research designs if policymakers are to truly understand the effect NP SOP reform may have on the U.S. health care system.

Tying Scope-of-Practice Measures and Educational Competencies

The U.S. health care system has developed a gap between the abilities of non-physician providers and the activities federal and state policies allow them to perform in professional practice (Dower et al., 2013). Many non-physician professions such as NPs and pharmacists have also undergone additional professionalization in recent years which has resulted in even more advanced clinical skills and further education. State SOP policies for many of these non-physician providers vary widely by state as has been demonstrated throughout this dissertation by examining the SOP specific to the NP workforce. As a result, professions continuing to require more education and state policies limiting various aspects of practice, these health professionals are not fully leveraged in a manner that is consistent with their training. This mismatch between provider abilities and legally permissible professional practice activities has caused many non-physician providers to be underutilized, creating a systemic inefficiency for the U.S. health care system.

The pharmacist workforce provides a great illustration of the mismatch between education and clinical practice. Since 2000, the PharmD (Doctorate of Pharmacy) has been the sole entry level degree to the pharmacy profession. This transition was inspired by the evolving advanced clinical roles pharmacists were taking on. For example, PharmD curricula now includes assessment of clinical competency in medication therapy management (MTM). MTM involves clinical expertise in evaluating complicated medication regimens, identifying medication-related issues, and making recommendations to patients, caregivers, and health care professionals. Although MTM competency is assessed among PharmD students as part of their training, only four states (Delaware, North Carolina, North Dakota, and South Carolina) allow pharmacists to manage drug therapies without a practice agreement with a supervising physician (*Pharmacist Scope-of-practice Laws*, 2015).

Furthermore, the cost of attending pharmacy school has increased considerably since the PharmD entry point was implemented in 2000. With the increase in educational requirements, pharmacy students have to pay an average of $25,000 per year in order to attend pharmacy school (Cain et al., 2014) and most graduates are faced with an extensive debt burden. For example, in 2012, pharmacy school graduates had a student debt load of $123,063 on average (Cain et al., 2014). Other health professions including medicine and dentistry have experienced similar concerns.

The disconnect between professional, political, and business interests has created inefficiencies such as increased student debt as a result of additional education that does not actually translate into additional capacity in practice. Researchers are now faced with

the task of understanding these inefficiencies and evaluating the impact of aligning scope-of-practice with educational competencies.

Future research is needed to further examine NP educational competencies and state scope-of-practice policies to help inform policy discussions. For example, the AANP suggests that policymakers should adopt "full practice" authority for NPs. They further define full practice authority as allowing NPs the ability to evaluate patients, diagnose, order, and interpret diagnostic tests, initiate and manage treatments—including prescribing medications—under the exclusive licensure authority of the state board of nursing (American Association of Nurse Practitioners, 2015). Researchers have commonly used the AANP categorical coding scheme of full practice, reduced practice, or restricted practice to demonstrate the impact of NP SOP on various measure of health care delivery. However, research that uses a more precise measure of NP SOP (such as the NPPPI which documents over 26 NP SOP policies) and ties these policies directly to NP educational competencies may result in more meaningful translations of findings to policymakers and support policy action.

APPENDICES

APPENDIX A: Supplemental Materials for Chapter Three

Complex Sample Survey Design

In order to obtain a representative sample of NPs in the United States, HRSA obtained listings of all actively licensed NPs from each state licensing board. A single national sampling frame was created using probability matching to identify and eliminate multiple records of the same NP. A sample of NPs was selected from each state (strata) with probability proportional to size. Data were collected from March 2012 through July 2012 in three waves of mailed paper surveys plus a reminder postcard. Approximately 13,000 NPs completed and returned surveys, signifying a response rate of 60.1 percent. Sample weights were developed to account for sampling design and non-response making the data from the survey representative at the national level and at the state-level for the larger states. Jackknife replicate weights were developed to facilitate variance estimation. Each response was carefully reviewed for missing or inaccurate data. A stepwise data cleaning process was applied to identify and consistently clean conflicting and out of range data. In addition, upcoding procedures were applied in order to standardize specified responses and other extraneous data.

Sample Weights and Normalization

In order to produce accurate estimates from NSSNP data, for either descriptive statistics or more sophisticated analyses based on multivariate models sample weights were normalized by dividing the survey weight of each unit used in the analysis by the unweighted average of the survey weights of all the analyzed units. The following formula was used for the normalization of sample weights:

$$w_k^{std} = \frac{w_k^{final}}{\overline{w}^{final}}$$

Where w_k^{std} is the normalized weight for observation *k*, w_k^{final} is the final sample weight for observation *k*, and $\overline{w}^{final}$ is the unweighted average of the survey weights of all the analyzed units.

Missing Data

Approximately, 19.04 percent of the data was missing at least one variable within an observation. These data were determined to be missing at random and in an arbitrary missing pattern (Chattopadhyay, 2016). Therefore, we conducted multiple imputation using PROC MI in SAS, version 9.4 and specifying the FCS method. All outcome measures and covariates explored in the study were included in the imputation model. We performed a total of ten imputations and conducted all planned analyses on each imputed data set. Results from the analyses were then combined with these results using PROC MIANALYSIS which is consistent with Rubin's standard rules (Rubin, 1987).

Table A.1:

Univariate Regression Analysis - % Time Spent In Patient Care

	≥ 85% in Patient Care				Univariate Regression Results			
	Yes (n=5,522)		No (n=5,569)		95% CL			
	N	%	N	%	OR	Lower	Upper	P
Gender								
Male	408	50.3	403	49.7	1.04	0.90	1.20	0.59
Female	5,070	49.3	5,209	50.7	Ref	Ref	Ref	Ref
Race								
White	5,048	50.7	4,909	49.3	Ref	Ref	Ref	Ref
Non-White	430	37.9	703	62.1	1.65	1.45	1.88	<.0001
Age								
≤ 34 years of age	752	49.4	769	50.6	0.76	0.66	0.87	<.0001
35-39 years of age	615	46.8	698	53.2	0.69	0.60	0.79	<.0001
40-44 years of age	596	43.3	780	56.7	0.59	0.52	0.68	<.0001
45-49 years or age	610	43.9	779	56.1	0.61	0.53	0.70	<.0001
50-54 years of age	825	49.1	855	50.9	0.75	0.66	0.86	<.0001
55-59 years of age	1,011	52.8	903	47.2	0.87	0.76	0.99	<.0001
≥ 60 years of age	1,069	56.4	828	43.6	Ref	Ref	Ref	Ref
Years of Experience								
20+ Years	1,262	48.1	1,363	51.9	0.71	0.63	0.80	<.0001
19-15 Years	1,131	45.8	1,340	54.2	0.65	0.57	0.74	<.0001
14-10 Years	1,182	47.3	1,318	52.7	0.69	0.61	0.78	<.0001
9-5 Years	944	52.2	865	47.8	0.84	0.73	0.96	0.01
≤ 4 Years	959	56.9	727	43.1	Ref	Ref	Ref	Ref
Highest Degree								
A.S. or Less	139	55.7	110	44.3	1.29	1.00	1.67	0.05
B.S.	214	57.6	157	42.4	1.36	1.10	1.68	0.00
Masters	4,851	49.7	4,911	50.3	Ref	Ref	Ref	Ref
Doctorate +	275	38.8	434	61.2	0.64	0.55	0.75	<.0001
Practice Setting								
Ambulatory	2,996	54.4	2,513	45.6	Ref	Ref	Ref	Ref
Hospital	1,606	45.2	1,946	54.8	0.48	0.40	0.58	<.0001
Long term care	233	46.1	273	54.0	0.72	0.65	0.81	0.01
Public health	386	50.5	378	49.5	0.79	0.65	0.95	0.05
Academic	258	34.0	501	66.0	0.82	0.68	1.00	<.0001
Marital Status								
Married	4,072	49.7	4,124	50.3	Ref	Ref	Ref	Ref
Single	1,407	46.6	1,488	51.4	1.04	0.96	1.14	0.32

Table A.1:

Continued

	Greater than 85% in Patient Care				Univariate Regression Results			
	Yes (n=5,522)		No (n=5,569)		95% CL			
	N	%	N	%	OR	Lower	Upper	P
Practice Location								
Urban	4,583	48.7	486	51.3	Ref	Ref	Ref	Ref
Large Rural	520	53.6	451	46.4	1.20	1.05	1.38	0.01
Small Rural	241	55.8	191	44.2	1.31	1.07	1.59	0.01
Isolated	135	50.0	135	50.1	1.02	0.80	1.30	0.90
Specialty								
Primary Care	2,715	51.3	2,576	48.7	Ref	Ref	Ref	Ref
Internal Medicine	848	47.0	956	53.0	0.85	0.76	0.94	0.00
Surgical Specialties	475	49.1	493	50.9	0.92	0.80	1.06	0.23
Other	1,380	48.8	1,447	51.2	0.90	0.82	0.99	0.03
No Specialty	60	30.1	140	69.9	0.41	0.30	0.56	<.0001
Hours per week								
0-8 Hours	10	60.6	65	39.4	1.69	1.23	2.32	0.00
9-16 hours	248	63.7	142	36.3	1.92	1.55	2.38	<.0001
17-24 hours	549	55.3	444	44.7	1.36	1.18	1.56	<.0001
25-32 hours	765	53.4	668	46.6	1.24	1.10	1.39	0.00
33-40 hours	2,590	47.7	2,836	52.3	Ref	Ref	Ref	Ref
More than 40 hours	1,226	45.7	1,458	54.3	0.91	0.83	1.00	0.05
Income (2011 Pre Tax)								
Less than $50,000	764	57.0	575	43.0	1.50	1.33	1.70	<.0001
$50,001 to $87,500	2,150	50.8	2,038	49.2	1.17	1.07	1.27	0.00
$87,501 to $120,000	2,125	46.9	2,408	53.1	Ref	Ref	Ref	Ref
$120,001 to $250,000	439	44.6	545	55.4	0.92	0.80	1.06	0.24
NPPPI Category								
Excellent (90-100)	1,102	55.3	890	44.7	Ref	Ref	Ref	Ref
Favorable (79-89)	1,941	48.3	2,075	51.7	0.76	0.65	0.89	0.00
Satisfactory (70-79)	1,607	47.6	1,771	52.4	0.74	0.63	0.87	0.00
Limited (60-69)	385	46.6	441	53.4	0.72	0.53	0.96	0.03
Restricted (0-59)	443	50.4	435	49.6	0.79	0.62	1.00	0.05

Source: Author's analysis of the National Sample Survey of Nurse Practitioners, 2012

Table A.2:

Summary Statistics and Univariate Regression Results - Preventive Care

	Provide preventive care including screenings & immunizations								Univariate Regression Results			
NPPPI Category	Most Patients (n, %)		Some Patients (n, %)		Few Patients (n, %)		No Patients (n, %)		OR	95% CL		P
Excellent	1,071	53.77%	404	20.27%	284	14.25%	233	11.71%	Ref	Ref	Ref	Ref
Favorable	2,201	54.79%	785	19.54%	619	15.41%	412	10.27%	1.002	0.847	1.185	0.983
Satisfactory	1,856	54.96%	697	20.63%	540	15.99%	284	8.42%	1.075	0.909	1.272	0.400
Limited	451	54.58%	167	20.25%	104	12.54%	104	12.63%	1.075	0.778	1.484	0.662
Restricted	494	56.31%	127	14.52%	137	15.65%	119	13.52%	1.031	0.792	1.342	0.821
Gender												
Male	369	45.31%	165	20.28%	163	19.99%	118	14.42%	0.643	0.563	0.734	<.0001
Female	5,704	55.51%	2,015	19.61%	1,521	14.80%	1,036	10.08%	Ref	Ref	Ref	Ref
Race												
White	5,370	53.94%	2,003	20.11%	1,547	15.54%	1,036	10.41%	Ref	Ref	Ref	Ref
Non-White	704	62.00%	178	15.65%	137	12.04%	117	10.31%	1.309	1.155	1.483	<.0001
Age												
≤ 34 years of age	813	53.47%	306	20.12%	270	17.75%	132	8.66%	0.944	0.829	1.075	0.3855
35-39 years of age	693	52.73%	245	18.68%	242	18.42%	134	10.17%	0.882	0.771	1.009	0.068
40-44 years of age	709	51.53%	277	20.10%	251	18.24%	139	10.12%	0.860	0.753	0.982	0.026
45-49 years or age	760	54.68%	269	19.36%	232	16.73%	128	9.22%	0.977	0.855	1.116	0.728
50-54 years of age	930	55.36%	342	20.35%	236	14.04%	172	10.24%	1.002	0.883	1.138	0.970
55-59 years of age	1,109	57.92%	353	18.46%	253	13.22%	199	10.41%	1.093	0.966	1.237	0.159
≥ 60 years of age	1,060	55.90%	388	20.45%	199	10.52%	249	13.14%	Ref	Ref	Ref	Ref
Years of Experience												
20+ Years	1,349	51.40%	546	20.80%	473	18.04%	256	9.77%	0.719	0.638	0.811	<.0001
19-15 Years	1,284	51.96%	463	18.75%	457	18.48%	267	10.80%	0.707	0.626	0.798	<.0001
14-10 Years	1,358	54.31%	519	20.78%	373	14.93%	249	9.98%	0.809	0.716	0.913	0.001
9-5 Years	1,062	58.71%	344	18.99%	224	12.37%	180	9.93%	0.949	0.832	1.082	0.433
≤ 4 Years	1,021	60.53%	308	18.25%	157	9.31%	201	11.91%	Ref	Ref	Ref	Ref

Table A.2:

Continued

	Provide preventive care including screenings & immunizations								Univariate Regression Results			
Practice Setting	Most Patients (n, %)		Some Patients (n, %)		Few Patients (n, %)		No Patients (n, %)		OR	95% CL	P	
Ambulatory	3,572	65.12%	1,043	19.01%	525	9.56%	345	6.30%	Ref	Ref	Ref	Ref
Hospital	1,329	37.24%	749	20.99%	907	25.42%	584	16.35%	0.305	0.281	0.331	<.0001
Long term/elder care	238	46.10%	112	21.64%	95	18.37%	72	13.90%	0.441	0.372	0.522	<.0001
Public/community health	538	69.85%	108	14.02%	58	7.48%	67	8.65%	1.154	0.982	1.357	0.083
Academic	396	52.85%	168	22.46%	100	13.28%	86	11.41%	0.592	0.511	0.685	<.0001
Marital Status												
Married	4,569	55.71%	1,625	19.82%	1,203	14.67%	804	9.80%	Ref	Ref	Ref	Ref
Single	1,504	52.06%	555	19.21%	481	16.65%	349	12.08%	1.196	1.103	1.296	<.0001
Practice Location												
Urban	4,998	53.05%	1,870	19.85%	1,504	15.97%	1,048	11.13%	Ref	Ref	Ref	Ref
Large Rural	581	60.17%	193	20.00%	122	12.66%	69	7.17%	1.394	1.222	1.591	<.0001
Small Rural	291	67.25%	73	16.86%	46	10.53%	23	5.36%	1.894	1.547	2.317	<.0001
Isolated	203	74.86%	44	16.22%	12	4.33%	12	4.60%	2.826	2.146	3.722	<.0001
Specialty												
Primary Care	4,139	78.30%	869	16.43%	204	3.86%	75	1.41%	Ref	Ref	Ref	Ref
Internal Med Specialties	761	42.11%	463	27.25%	388	21.47%	166	9.17%	0.196	0.176	0.219	<.0001
Surgical Specialties	152	15.83%	154	16.00%	321	33.31%	336	34.86%	0.044	0.038	0.050	<.0001
Other	945	33.34%	621	28.49%	747	26.37%	521	18.37%	0.115	0.104	0.127	<.0001
No Specialty	76	38.00%	44	21.84%	24	11.94%	56	28.23%	0.119	0.090	0.157	<.0001

Table A.2:

Continued

	Provide preventive care including screenings & immunizations								Univariate Regression Results			
Hours per week	Most Patients (n, %)		Some Patients (n, %)		Few Patients (n, %)		No Patients (n, %)		OR	95% CL		P
0-8 Hours	91	56.05%	29	17.80%	20	12.24%	22	13.91%	1.014	0.748	1.376	0.9283
9-16 hours	205	52.84%	80	20.59%	53	13.67%	50	12.90%	0.931	0.765	1.133	0.476
17-24 hours	566	56.59%	190	18.95%	133	13.26%	112	11.17%	1.077	0.945	1.228	0.265
25-32 hours	857	60.16%	286	20.08%	152	10.69%	129	9.07%	1.287	1.147	1.444	<.0001
33-40 hours	2,959	54.44%	1,073	19.75%	830	15.28%	572	10.53%	Ref	Ref	Ref	Ref
More than 40 hours	1,397	52.07%	523	19.49%	496	18.48%	267	9.97%	0.918	0.840	1.002	0.055
Income (2011 Pre Tax)												
Less than $50,000	747	56.90%	242	18.41%	168	12.76%	157	11.93%	1.161	1.030	1.308	0.0142
$50,001 to $87,500	2,529	59.22%	823	19.27%	571	13.36%	348	8.15%	1.356	1.251	1.251	<.0001
$87,501 to $120,000	2,356	52.07%	939	20.75%	767	16.96%	462	10.21%	Ref	Ref	Ref	Ref
$120,001 to $250,000	441	44.90%	177	17.98%	178	18.15%	186	18.97%	0.642	0.563	0.563	<.0001
Highest Degree												
Associates or Less	178	71.91%	38	15.53%	16	6.64%	15	5.93%	2.162	1.639	2.853	<.0001
Baccalaureate	244	65.10%	59	15.77%	22	5.83%	50	13.30%	1.460	1.179	1.808	0.001
Masters	5,255	53.84%	1,946	19.94%	1,542	15.80%	1,017	10.42%	Ref	Ref	Ref	Ref
Doctorate or higher	397	55.96%	137	19.28%	104	14.67%	72	10.09%	1.089	0.940	1.261	0.256

Source: Author's analysis of the National Sample Survey of Nurse Practitioners, 2012

APPENDIX B: Supplemental Materials for Chapter Four

State-Year File Construction

To perform the difference-in-differences analysis of patient level data aggregated to the state level, we first had to create the aggregated state year file. Eleven years (2002-2013) of patient level data from the Medical Expenditure Panel Survey (MEPS) Full Year Consolidated Data Files were merged into one longitudinal data file. Additional scope of practice variables were merged into the patient level longitudinal data file by the variable "state". The file was then aggregated to create a state-year data file. This file contained eleven years of data for each state. Aggregation was completed by taking the mean of all of the outcomes and independent variables of interest. All categorical variables with more than two response options were dichotomized into a binary variable which allowed for the calculation of the mean. Details on how these categorical variables were dichotomized is provided in table B.1.

Regression specifications

The effects of changes to reimbursement and supervision policies on the proportion of USCs that are NPs, travel times to USC providers, and appointment availability were model using a two-way fixed effects approach. The two-way fixed effects models include both state and year fixed effects and is a generalized approach to difference-in-differences modeling (Wooldridge, 2010). The model specifications took the basic functional form illustrated in equation 1.

$$(1)\ Y_{it} = \beta_0 + \beta_1 Policy1_{it} + \beta_2 Policy2_{it} + \beta_3 \boldsymbol{Z_{it}} + \boldsymbol{v_i} + \boldsymbol{u_t} + \varepsilon_{it}$$

Equation 1. General regression equation for the two-way fixed effects models.

Where Y_{it} is the mean of the study outcome for state i at year t. $Policy1_{it}$ is the presence of the medical record review requirements (supervision) for state i at year t. $Policy2_{it}$ is the presence of the legal right to be listed on patient panels (reimbursement) for state i at year t. $\boldsymbol{Z_{it}}$ is a vector of state time-varying covariates affecting exposure (percent male, age, insurance coverage, income, white, Hispanic, health status). $\boldsymbol{v_i}$ is a vector of state dummy variables, and $\boldsymbol{u_t}$ is a vector of year dummy variables. ε_{ij} is the error term that is assumed to be uncorrelated with all the right hand side variables. The specific regression models are displayed in the following equations.

(1) $Proportion\ USC\ NP_{it} = \beta_0 + \beta_1 Policy1_{it} + \beta_2 Policy2_{it} + \beta_3 \boldsymbol{Z_{it}} + \boldsymbol{v_i} + \boldsymbol{u_t} + \varepsilon_{it}$

Equation 1. Regression equation for the two-way fixed effects model assessing the proportion of the proportion of USC providers that are NPs.

(2) $Travel\ Time_{it} = \beta_0 + \beta_1 Policy1_{it} + \beta_2 Policy2_{it} + \beta_3 \boldsymbol{Z_{it}} + \boldsymbol{v_i} + \boldsymbol{u_t} + \varepsilon_{it}$

Equation 2. Regression equation for the two-way fixed effects model assessing the proportion of the people reporting travel times of 30 minutes or less to their USC provider.

(3) $Appointment\ Availability_{it} = \beta_0 + \beta_1 Policy1_{it} + \beta_2 Policy2_{it} + \beta_3 \boldsymbol{Z_{it}} + \boldsymbol{v_i} + \boldsymbol{u_t} + \varepsilon_{it}$

Equation 2. Regression equation for the two-way fixed effects model assessing the proportion of people reporting "always" getting an appointment when they wanted.

Software Implementation

All statistical analyses for this dissertation are performed using SAS© Version 9.4. The PROC PANEL procedure is used to run the two-way fixed effects models in

these analyses. The PANEL procedure is a powerful tool for fitting linear regression models to panel data (SAS Institute, 2016). Formally, for a panel of *N* individuals, PROC PANEL considers the following linear regression equation:

$$(4)\ Y_{it} = \beta_0 + \beta_x X_{it} + \beta_z \boldsymbol{Z_t} + \boldsymbol{v_t} + \varepsilon_{it}$$

where i denotes the individual and t is any one of T time points. The regression model has two sets of explanatory variables: a set of **X** variables that vary over time and a set of **Z** variables that do not vary over time. The $\boldsymbol{v_t}$ are known as individual (or cross-sectional) effects, and the ϵit are the observation-level regression errors. PROC PANEL provides several ways to fit the preceding regression model including the specification of two-way fixed effect to include $\boldsymbol{u_t}$ known as time (or time-series) effects.

The general syntax used for implementation of the PROC PANEL procedure used for these analyses is as follows:

```
PROC PANEL data=MEPS printfixed;
    id state year;
    model USCNP = Policy1 Policy2 income insurance white male Hispanic
    healthstatus age / fixtwo; run;
```

Table B.1:

Outcome Measures - Definitions and Calculations

Variable	Definition	Value
Outcome Measures		
Usual Source of Care – Nurse Practitioner	The proportion of usual source of care providers that are nurse practitioners. *"Is [PROVIDER] a nurse, nurse practitioner, physician's assistant, midwife, or some other kind of person?"*	Continuous value between 0 and 1
Travel Time	The proportion of individuals who reported traveling 30 minutes or less to their usual source of care provider. *"How long does it usually take you to get to your USC provider?"* **Original Values:** *1=Less Than 15 Minutes* *2=15 to 30 Minutes* *3=31 to 60 Minutes* *4=61 to 90 Minutes* *5=91 Minutes to 120 Minutes* *6=More Than 120 Minutes*	Continuous value between 0 and 1
Appointment Availability	The proportion of individuals who reported "always" able to get an appointment for you health care as soon as you thought you needed it. *"In the last 12 months, not counting the times you needed care right away, how often did you get an appointment for your health care at a doctor's office or clinic as soon as you thought you needed?"* **Original Values:** 1=Never 2=Sometimes 3=Usually 4=Always	Continuous value between 0 and 1

Table B.2:

Independent Variable Definitions and Calculations

Variable	Definition	Value
Independent Variables		
Male	The proportion of individuals reporting their gender as male.	Continuous value between 0 and 1
Age	Mean age.	Continuous value >0
Insurance Coverage	The proportion or individuals reporting any public or private insurance.	Continuous value between 0 and 1
Income	Mean person-level income.	Continuous value >0
White	The proportion of individuals reporting their race as white.	Continuous value between 0 and 1
Hispanic	The proportion of individuals reporting their ethnicity as Hispanic or Latino.	Continuous value between 0 and 1
Good Health	The proportion of individuals reporting their self-perceived health status to be excellent, very good, or good.	Continuous value between 0 and 1

SAS Output Model 1: Usual Source of Care

(1) $Proportion\ USC\ NP_{it} = \beta_0 + \beta_1 Policy1_{it} + \beta_2 Policy2_{it} + \beta_3 \boldsymbol{Z_{it}} + \boldsymbol{v_i} + \boldsymbol{u_t} + \varepsilon_{it}$

Table B.3: Model Description	
Estimation Method	FixTwo
Number of Cross Sections	48
Time Series Length	11

Table B.4: Fit Statistics			
SSE	0.3284	*DFE*	461
MSE	0.0007	*Root MSE*	0.0267
R-Square	0.3464		

Table B.5: F Test for No Fixed Effects

Num DF	*Den DF*	*F Value*	*Pr > F*
57	461	3.74	<.0001

Table B.6: Parameter Estimates

Variable	*DF*	*Estimate*	*Standard Error*	*t Value*	*Pr > |t|*	*Label*
Intercept	1	-0.03142	0.0625	-0.50	0.6152	Intercept
legal_1	1	0.013916	0.00742	1.88	0.0614	Reimbursement - One-year lag
REVIEWREQ_1	1	0.00621	0.00961	0.65	0.5186	Supervision - One-year lag
INCOME	1	0.019661	0.00980	2.01	0.0454	Income
INSCOV	1	0.022108	0.0169	1.31	0.1908	Insurance Coverage
WHITE	1	0.03888	0.0210	1.85	0.0650	Percent white
MALE	1	-0.02991	0.0400	-0.75	0.4551	Percent male
HISPANIC	1	-0.06173	0.0237	-2.61	0.0094	Percent Hispanic
GOODHLTH	1	-0.0019	0.0458	-0.04	0.9669	Health Status
AGEM	1	-0.00034	0.000502	-0.68	0.4959	Age

SAS Output Model 2: Travel Time

(2) $Travel\ Time_{it} = \beta_0 + \beta_1 Policy1_{it} + \beta_2 Policy2_{it} + \beta_3 \boldsymbol{Z_{it}} + \boldsymbol{v_i} + \boldsymbol{u_t} + \varepsilon_{it}$

Table B.7: Model Description

Estimation Method	FixTwo
Number of Cross Sections	48
Time Series Length	11

Table B.8: Fit Statistics

SSE	0.7729	*DFE*	461
MSE	0.0017	*Root MSE*	0.0409
R-Square	0.5389		

Table B.9: F Test for No Fixed Effects

Num DF	*Den DF*	*F Value*	*Pr > F*
57	461	5.59	<.0001

Table B.10: Parameter Estimates

Variable	*DF*	*Estimate*	*Standard Error*	*t Value*	*Pr > |t|*	*Label*
Intercept	1	0.905606	0.0958	9.45	<.0001	Intercept
legal_1	1	0.019933	0.0114	1.75	0.0806	Reimbursement - 1-year lag
REVIEWREQ_1	1	0.028575	0.0147	1.94	0.0532	Supervision - One-year lag
INCOME	1	0.067696	0.0150	4.50	<.0001	Income
INSCOV	1	-0.04712	0.0259	-1.82	0.0694	Insurance Coverage
WHITE	1	-0.07637	0.0322	-2.37	0.0183	Percent white
MALE	1	-0.17116	0.0614	-2.79	0.0055	Percent male
HISPANIC	1	0.010614	0.0363	0.29	0.7700	Percent Hispanic
GOODHLTH	1	0.147072	0.0702	2.09	0.0368	Health Status
AGEM	1	-0.00176	0.000769	-2.29	0.0223	Age

SAS Output Model 3: Appointment Availability

(3) $Appointment\ Availability_{it} = \beta_0 + \beta_1 Policy1_{it} + \beta_2 Policy2_{it} + \beta_3 \boldsymbol{Z_{it}} + \boldsymbol{v_i} + \boldsymbol{u_t} + \varepsilon_{it}$

Table B.11: Model Description

Estimation Method	FixTwo
Number of Cross Sections	48
Time Series Length	11

*Table B.12:*Fit Statistics

SSE	1.7736	*DFE*	461
MSE	0.0038	*Root MSE*	0.0620
R-Square	0.4405		

Table B.13: F Test for No Fixed Effects

Num DF	*Den DF*	*F Value*	*Pr > F*
57	461	4.97	<.0001

Table B.14: Parameter Estimates

Variable	*DF*	*Estimate*	*Standard Error*	*t Value*	*Pr > |t|*	*Label*
Intercept	1	0.143745	0.1452	0.99	0.3225	Intercept
legal_1	1	-0.02216	0.0172	-1.29	0.1994	Reimbursement - 1-year lag
REVIEWREQ_1	1	-0.00028	0.0223	-0.01	0.9901	Supervision - One-year lag
INCOME	1	-0.01219	0.0228	-0.54	0.5926	Income
INSCOV	1	0.088389	0.0392	2.25	0.0247	Insurance Coverage
WHITE	1	0.033346	0.0488	0.68	0.4952	Percent white
MALE	1	-0.05026	0.0930	-0.54	0.5891	Percent male
HISPANIC	1	0.009398	0.0550	0.17	0.8643	Percent hispanic
GOODHLTH	1	0.186636	0.1064	1.75	0.0801	Health Status
AGEM	1	0.003156	0.00117	2.71	0.0070	Age

Sensitivity Analysis

The effect of new or changing policies is not immediate. The SOP policies used in the study were documented by the time in which the policies were actually implemented. However, there may have been additional time required before any measureable change to the outcomes was noticeable. As such, the primary model presented includes a one year lag to account for the time for policy implementation. Furthermore, sensitivity analyses included the inclusion of a two year lag to determine if greater effects were found when allowing for additional time for changes to be realized in the health system.

Lag variables were created using the PROC PANEL procedure in SAS. The PANEL procedure now enables you to generate lags of any series without jumping across the boundary of any individual series (SAS Institute, 2017). The LAG statement is a data set generation tool. The following code was used to create the lag dataset that was used for the primary analysis as well as the sensitivity analyses implement this procedure:

```
PROC PANEL data=MEPS;
        id state year;
        lag Policy1(1 2) Policy2(1 2) out=data_lag;
        run;
```

Sensitivity Analysis Regression Results

Model 1: Usual Source of Care

Table B.15: Model Description	
Estimation Method	FixTwo
Number of Cross Sections	48
Time Series Length	10

Table B.16: Fit Statistics			
SSE	0.3092	*DFE*	414
MSE	0.0007	*Root MSE*	0.0273
R-Square	0.3700		

Table B.17: F Test for No Fixed Effects			
Num DF	*Den DF*	*F Value*	*Pr > F*
56	414	3.74	<.0001

Table B.18: Parameter Estimates						
Variable	*DF*	*Estimate*	*Standard Error*	*t Value*	*Pr > |t|*	*Label*
Intercept	1	-0.02957	0.0671	-0.44	0.6596	Intercept
legal_2	1	0.02019	0.00784	2.58	0.0104	
REVIEWREQ_2	1	0.003944	0.0112	0.35	0.7256	
INCOME	1	0.022412	0.0104	2.16	0.0313	Income
INSCOV	1	0.026527	0.0185	1.44	0.1516	Insurance Coverage
WHITE	1	0.039418	0.0229	1.72	0.0854	Percent white
MALE	1	-0.02393	0.0434	-0.55	0.5820	Percent male
HISPANIC	1	-0.06184	0.0257	-2.41	0.0166	Percent Hispanic
GOODHLTH	1	-0.01309	0.0509	-0.26	0.7973	Health Status
AGEM	1	-0.00045	0.000560	-0.80	0.4235	Age

Model 2: Travel Times

Table B.19: Model Description	
Estimation Method	FixTwo
Number of Cross Sections	48
Time Series Length	10

Table B.20: Fit Statistics			
SSE	0.6552	*DFE*	414
MSE	0.0016	*Root MSE*	0.0398
R-Square	0.5101		

Table B.21: F Test for No Fixed Effects			
Num DF	*Den DF*	*F Value*	*Pr > F*
56	414	4.51	<.0001

Table B.22: Parameter Estimates						
Variable	*DF*	*Estimate*	*Standard Error*	*t Value*	*Pr > |t|*	*Label*
Intercept	1	0.939884	0.0976	9.63	<.0001	Intercept
legal_2	1	0.015996	0.0114	1.40	0.1617	
REVIEWREQ_2	1	0.039256	0.0163	2.40	0.0168	
INCOME	1	0.071095	0.0151	4.71	<.0001	Income
INSCOV	1	-0.02849	0.0269	-1.06	0.2898	Insurance Coverage
WHITE	1	-0.06478	0.0333	-1.95	0.0522	Percent white
MALE	1	-0.10632	0.0632	-1.68	0.0935	Percent male
HISPANIC	1	0.004686	0.0374	0.13	0.9004	Percent Hispanic
GOODHLTH	1	0.034078	0.0742	0.46	0.6461	Health Status
AGEM	1	-0.00226	0.000816	-2.77	0.0058	Age

Model 3: Appointment Availability

Table B.23: Model Description	
Estimation Method	FixTwo
Number of Cross Sections	48
Time Series Length	10

Table B.24: Fit Statistics			
SSE	1.5982	*DFE*	414
MSE	0.0039	*Root MSE*	0.0621
R-Square	0.4555		

Table B.25: F Test for No Fixed Effects			
Num DF	*Den DF*	*F Value*	*Pr > F*
56	414	4.88	<.0001

Table B.26: Parameter Estimates

Variable	*DF*	*Estimate*	*Standard Error*	*t Value*	*Pr > |t|*	*Label*
Intercept	1	0.232163	0.1525	1.52	0.1287	Intercept
legal_2	1	0.005351	0.0178	0.30	0.7641	
REVIEWREQ_2	1	0.012139	0.0255	0.48	0.6347	
INCOME	1	-0.00428	0.0236	-0.18	0.8562	Income
INSCOV	1	0.083643	0.0420	1.99	0.0470	Insurance Coverage
WHITE	1	0.049415	0.0520	0.95	0.3422	Percent white
MALE	1	-0.10747	0.0988	-1.09	0.2771	Percent male
HISPANIC	1	0.009807	0.0584	0.17	0.8668	Percent hispanic
GOODHLTH	1	0.090958	0.1158	0.79	0.4327	Health Status
AGEM	1	0.002928	0.00127	2.30	0.0221	Age

Assessment of Internal Validity

A spurious correlation describes a relationship in which two or more variables are not causally related to each other (i.e. they are independent), yet it may be wrongly inferred that they are, due to the presence of unobserved confounding factors. The presence of this type of bias threatens internal validity of nonrandomized research studies. Control outcomes or control exposures may improve internal validity of nonrandomized studies by assessing the residual bias in effect estimates. Control outcomes are outcomes that are expected to have no treatment effect on the primary outcome being studied (Dusetzina, Brookhart, & Maciejewski, 2015).

The use of randomized control research designs is often not possible in policy research or health services research due to time, cost, or logistical constraints. However, researchers are often able to conduct observational studies, assess the internal validity of such studies, and assess spurious relationships that may cause inappropriate causal inference. To appropriately assess internal validity researchers must have adequate subject-matter knowledge to be able to identify outcomes that are not expected to change in response to the intervention of interest (Dusetzina et al., 2015). Researchers using secondary data for comparative effectiveness research have to address limitations regarding a lack of information on known confounders (since known confounders may be unmeasured) and potential gaps in subject-matter knowledge that reduce the likelihood of estimating causal effects without bias (Brookhart, Sturmer, Glynn, Rassen, & Schneeweiss, 2010).

Control Outcome

Unobserved factors that vary by state are potential confounders in this study. As such, we decided to examine violent crime rates as a control outcome. Violent crime rates vary by state and are expected to be influenced by various state factors in a manner similar to our primary analyses.

The Bureau of Justice Statistics' (BJS) National Crime Victimization Survey (NCVS) is the nation's primary source of information on criminal victimization. Each year, data are obtained from a nationally representative sample of about 90,000 households, comprising nearly 160,000 persons, on the frequency, characteristics, and consequences of criminal victimization in the United States. The NCVS collects information on nonfatal personal crimes (rape or sexual assault, robbery, aggravated and simple assault, and personal larceny) and household property crimes (burglary, motor vehicle theft, and other theft) both reported and not reported to police. Survey respondents provide information about themselves (e.g., age, sex, race and Hispanic origin, marital status, education level, and income) and whether they experienced a victimization. For each victimization incident, the NCVS collects information about the offender (e.g., age, race and Hispanic origin, sex, and victim-offender relationship), characteristics of the crime (including time and place of occurrence, use of weapons, nature of injury, and economic consequences), whether the crime was reported to police, reasons the crime was or was not reported, and victim experiences with the criminal justice system. The NCVS relies on a sample rather than a census of the entire U.S. population. Therefore, weights are designed to inflate sample point estimates to known

population totals and to compensate for survey nonresponse and other aspects of the sample design.

Control Outcome – Results

Table B.27: Model Description	
Estimation Method	FixTwo
Number of Cross Sections	48
Time Series Length	11

Table B.28: Fit Statistics			
SSE	588866.6074	*DFE*	461
MSE	1277.3679	*Root MSE*	35.7403
R-Square	0.9748		

Table B.29: F Test for No Fixed Effects			
Num DF	*Den DF*	*F Value*	*Pr > F*
57	461	226.02	<.0001

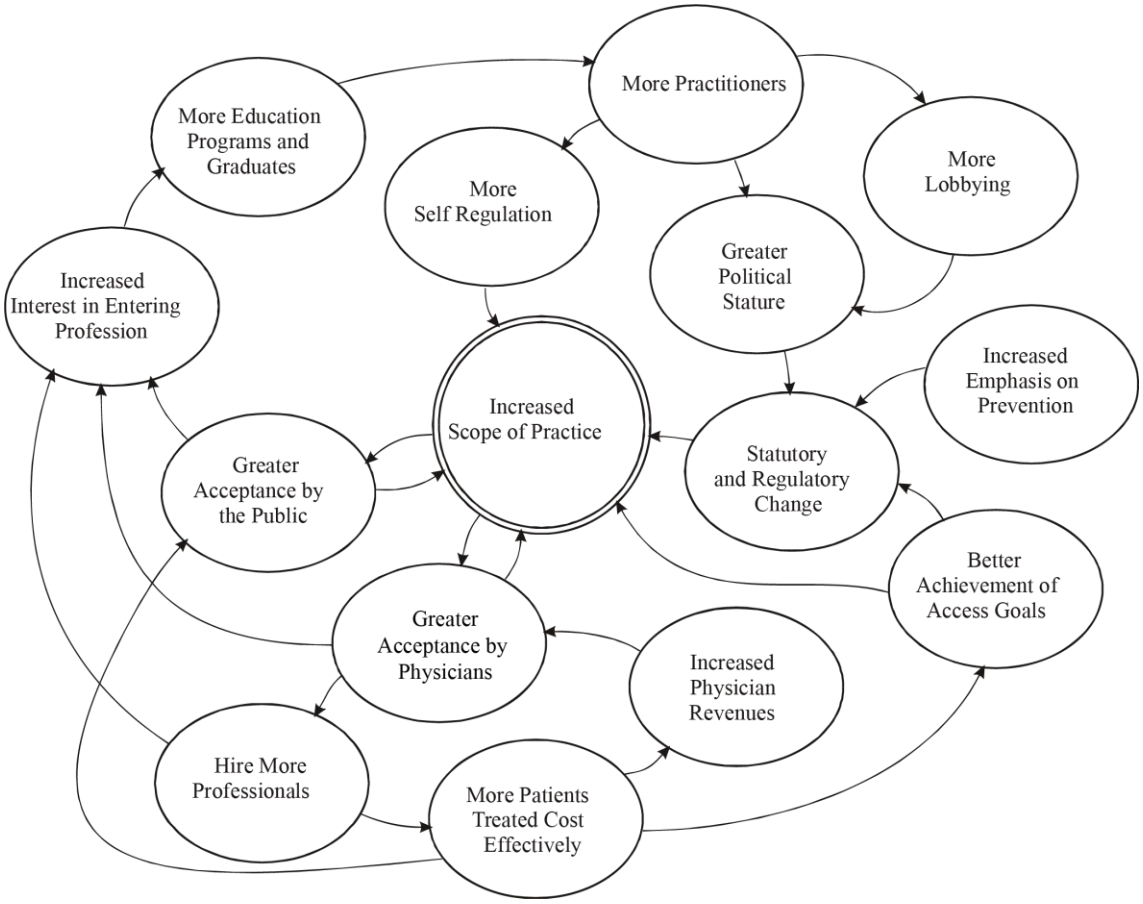
Table B.30: Parameter Estimates

Variable	*DF*	*Estimate*	*Standard Error*	*t Value*	*Pr > |t|*	*Label*
Intercept	1	214.5993	83.6374	2.57	0.0106	Intercept
legal_1	1	0.762642	9.9370	0.08	0.9389	Reimbursement - One-year lag
REVIEWREQ_1	1	-4.74715	12.8700	-0.37	0.7124	Supervision - One-year lag
INCOME	1	29.59725	13.1228	2.26	0.0246	Income
INSCOV	1	-41.6667	22.5960	-1.84	0.0658	Insurance Coverage
WHITE	1	54.06981	28.1467	1.92	0.0553	Percent white
MALE	1	-85.3101	53.5739	-1.59	0.1120	Percent male
HISPANIC	1	31.36802	31.6764	0.99	0.3226	Percent Hispanic
GOODHLTH	1	30.15125	61.3042	0.49	0.6231	Health Status

Table B.30: Parameter Estimates

Variable	*DF*	*Estimate*	*Standard Error*	*t Value*	*Pr > |t|*	*Label*
AGEM	1	-0.794	0.6716	-1.18	0.2377	Age

Figure B.1. Factors influencing NP scope of practice (Health Resources and Services Administration, 2004).



APPENDIX C: Supplemental Information for Chapter Five

Figure C.1. The percent of primary health care need met by state, 2017

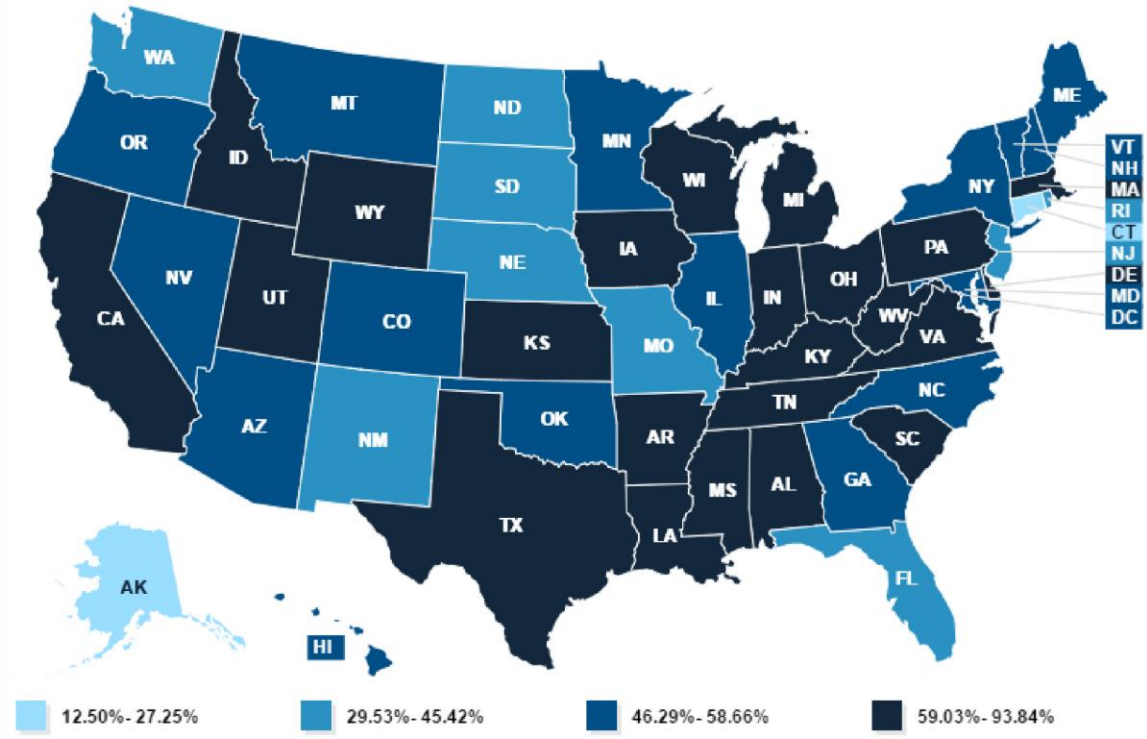


Table C.1:

Primary Care Health Professional Shortage Areas (HPSAs): Percent of Need Met

Location	Percent of Need Met	Number of practitioners to remove HPSA
United States	***56.8%***	***8,644***
Alabama	73.9%	158
Alaska	27.3%	35
Arizona	52.5%	422
Arkansas	62.9%	57
California	62.0%	851
Colorado	50.8%	154
Connecticut	12.5%	121
Delaware	93.8%	4
District of Columbia	50.4%	43
Florida	41.3%	1,010
Georgia	54.6%	370
Hawaii	52.2%	19
Idaho	62.0%	57
Illinois	58.7%	454
Indiana	72.3%	166
Iowa	63.5%	77
Kansas	64.3%	71
Kentucky	67.6%	106
Louisiana	77.8%	143
Maine	46.3%	16
Maryland	54.9%	169
Massachusetts	65.3%	58
Michigan	65.2%	233
Minnesota	54.4%	64
Mississippi	59.0%	236
Missouri	29.5%	367
Montana	52.1%	38
Nebraska	41.8%	5
Nevada	50.4%	99
New Hampshire	54.9%	13
New Jersey	34.0%	216
New Mexico	38.7%	786
New York	52.1%	14
North Carolina	53.1%	223
North Dakota	37.5%	30

Table C.1

Continued

Location	*Percent of Need Met	Number of practitioners to remove HPSA
Ohio	69.0%	145
Oklahoma	54.9%	188
Oregon	56.5%	141
Pennsylvania	63.6%	88
Rhode Island	32.8%	37
South Carolina	69.4%	156
South Dakota	44.3%	31
Tennessee	71.0%	139
Texas	66.4%	587
Utah	67.4%	64
Vermont	56.3%	1
Virginia	66.5%	143
Washington	45.4%	231
West Virginia	64.7%	63
Wisconsin	71.1%	88
Wyoming	69.8%	11

Source: Bureau of Clinician Recruitment and Service, Health Resources and Services Administration (HRSA), U.S. Department of Health & Human Services, [HRSA Data Warehouse: Designated Health Professional Shortage Areas Statistics, as of January 1, 2017](https://datawarehouse.hrsa.gov/Tools/HDWReports/Reports.aspx). **Notes** For primary medical care, the population to provider ratio must be at least 3,500 to 1 (3,000 to 1 if there are unusually high needs in the community). The number of primary care HPSA designations includes HPSAs that are proposed for withdrawal and HPSAs that have no data. By statute, designations are not withdrawn until a Federal Register Notice is published, generally once a year on or around July 1. The percent of need met is computed by dividing the number of physicians available to serve the population of the area, group, or facility by the number of physicians that would be necessary to eliminate the primary care HPSA (based on a ratio of 3,500 to 1 (3,000 to 1 where high needs are indicated)).

Figure C.2: The number of practitioners needed to remove the Health Professional Shortage Area designations, 2017

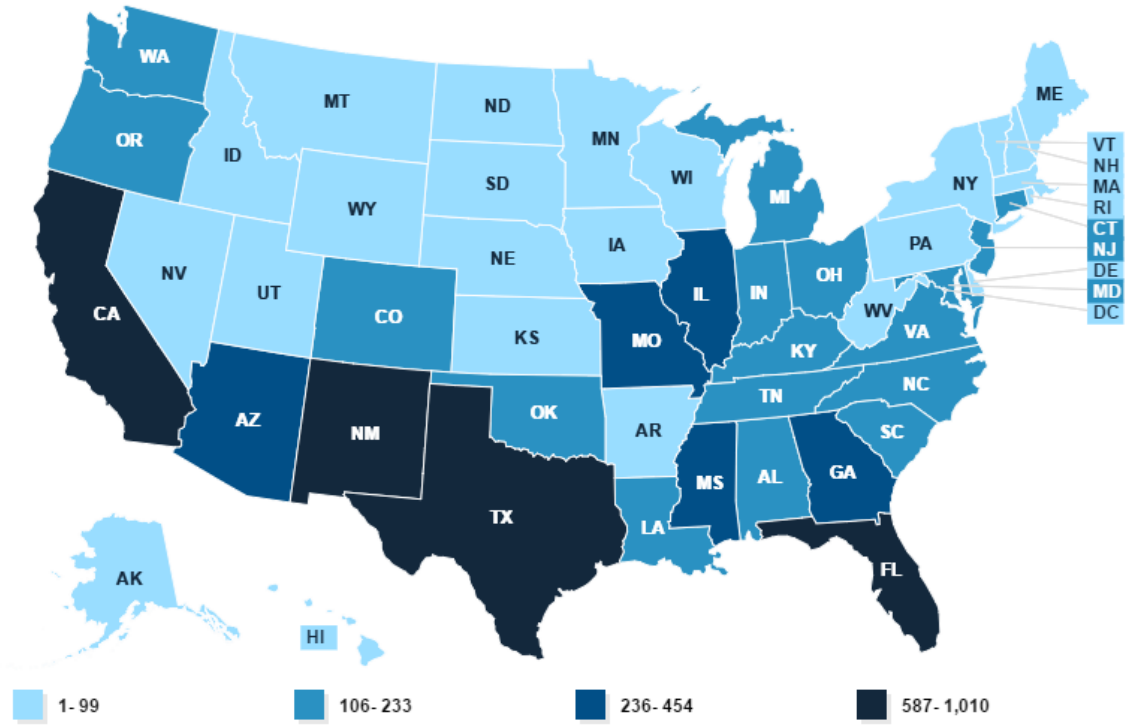


Table C.2:

Estimated impact of nurse practitioner scope of practice policies on a negative control outcome - violent crime rate in the United States,2002-2013

	One-Year Lag: Violent Crime Rate		Two-Year Lag: Violent Crime Rate	
	β	SE	β	SE
Scope of practice Policies				
Legal Provider (Reimbursement)[a]	0.763	9.937	6.959	9.574
Medical Record Review (Supervision)[b]	-4.747	12.870	10.104	13.714
Independent Variables				
Male	-85.310	53.574	-83.883	53.052
Age	-0.794	0.672	-1.782**	0.684
Insurance Coverage	-41.667	22.596	-61.551**	22.549
Income	29.597*	13.123	32.300*	12.671
White	54.070	28.147	50.295	27.916
Hispanic	31.368	31.676	10.176	31.391
Health Status- Good	30.151	61.304	-21.443	62.212

Sources: Authors analysis of violent crime rate data from 2002 to 2013. **Notes:** Marginal effects are reported. Robust standard errors clustered at the state level. Independent variables are defined in detail in the technical appendix. Additional detail on the violent crime rate data obtained from the U.S. Department of Justice is described in detail in the technical appendix. [a] Medical record review is defined as state policy requiring any medical record review by a physician. [b] Legal provider is defined as state policy providing NPs' the legal right to be listed on a patient panel as a primary care provider. *p <0.05 **p <0.01

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Yee, T., Boukus, E., Cross, D., & Samuel, D. (2013a). Primary Care Workforce Shortages: Nurse Practitioner Scope-of-Practice Laws and Payment Policies.

Yee, T., Boukus, E., Cross, D., & Samuel, D. (2013b). *Primary Care Workforce Shortages: Nurse Practitioner Scope-of-Practice Laws and Payment Policies*. Retrieved from Washington, DC:

Zaidi, S. A. (1986). Why medical students will not practice in rural areas: evidence from a survey. *Soc Sci Med, 22*(5), 527-533.

CURRICULUM VITAE

Connor W. Norwood

EDUCATION:
Doctor of Philosophy, Indiana University, 2017
Concentration: Health Policy and Management
Minor: Medical Sociology

Master of Health Administration, Indiana University Richard M. Fairbanks School of Public Health IUPUI, 2013

Bachelors of Science, Indiana University- Bloomington, 2011
Major: Neuroscience
Minors: Spanish, Chemistry, Biology

PROFESSIONAL APPOINTMENTS/EXPERIENCE

Bowen Center for Health Workforce Research and Policy,
Indiana University School of Medicine (Indianapolis, IN)
Assistant Director 2015-Present
Senior Policy Analyst 2014-2015

Department of Family Medicine,
Indiana University School of Medicine (Indianapolis, IN)
Faculty-Visiting Research Associate 2015-Present

Department of Health Policy and Management
IU Richard M. Fairbanks School of Public Health (Indianapolis, IN)
Associate Instructor 2013-2015

Indiana University Center for Aging Research,
Regenstrief Institute (Indianapolis, IN)
Research Assistant 2013-2014

PROFESSIONAL ORGANIZATION MEMBERSHIPS:

AcademyHealth 2013- Present

American Public Health Association 2013- Present

Indiana University Alumni Association 2013- Present

American Association for the Advancement of Science 2016-Present

Richard M. Fairbanks School of Public Health Ph.D. Student Association 2013- 2015

American College of Healthcare Executives 2011-2013

Healthcare Financial Management Association2011-2013

PROFESSIONAL HONORS AND AWARDS:

Supervisor of the Year
Nominated for Mentoring, Professionalism, Excellent Leadership 2016

Graduate and Professional Student Government Elite 50 Award
Awarded for being in the top 50 Graduate and Professional Student within the University 2015

Best of the IU Richard M. Fairbanks School of Public Health
Awarded to top student within the School 2015

TEACHING:

Course#	Title	Role	Term	Enrollment
PBHL-H353	Adv. Health Finance & Budgeting	Associate Instructor	FA 2014	16
PBHL-H501	U.S. Health Systems & Health Policy	Associate Instructor	SP 2015	21
PBHL-H670	Intro to Public Health	Teaching Assistant	SP 2014	1
PBHL-H705	Capstone MPH	Teaching Assistant	SP 2014	4
PBHL-H501	U.S. Health Systems & Health Policy	Associate Instructor	SU 2014	22
PBHL-H501	U.S. Health Systems & Health Policy	Teaching Assistant	FA 2013	45

GRANTS/CONTRACTS/FELLOWSHIPS:

Bowen Center for Health Workforce Research and Policy. (2015-2017). PI: Maxey, HL Funded by The Indiana State Department of Health (Total Funding: $1,000,648).
Role: Co-Investigator

Emergency Medical Service - Pediatrics Workforce. (2015-2016). PI: Maxey, HL Funded by The Indiana University Children's Health Services Research Center (Total Funding: $10,000).
Role: Co-Investigator

Indiana Primary Care Needs Assessment and Health Workforce Studies Database Updates. (2014-2019). PI: Maxey, HL Funded by The Indiana State Department of Health (Total Funding: $250,000).
Role: Co-Investigator

Evaluation of Network Development Intervention to Strengthen Indiana's Rural Health System through Primary Care-based Chronic Disease Management. (2014-2017). PI: Maxey, HL Funded by The Indiana Rural Health Association (Total Funding: $30,000).
Role: Researcher

Evaluation of National Health Service Corps (NHSC) Clinician Impact in Indiana and Existing Retention Strategies. (2012-2014). PI: Kiovsky, R. HL Funded by The Indiana State Department of Health, Office of Primary Care (Total Funding: $155,000).
Role: Researcher

Associate Instructorship. (2014-2015). Supported by the IU Richard M. Fairbanks School of Public Health. (Total Awarded $38,000)

Associate Instructorship. (2013-2014). Supported by the IU Richard M. Fairbanks School of Public Health. (Total Awarded $38,000)

SUBMITTED BUT NOT FUNDED GRANTS/CONTRACTS
Putting the Smile in Primary Care. (2015). PI: Maxey, H.L. Submitted to the Indiana University Health Values Grant, Grand Challenge.
Role: Researcher

Effect of Peer Support Intervention on Transplantation Attitudes and Outcomes for ESRD Patients on Hemodialysis: An Effectiveness Study (Pilot RCT Peer Mentoring Program). (Spring 2014). PI: Norman, S. Submitted to Patient-Centered Outcomes Research Institute (PCORI). Scored.
Role: Co-Investigator

An Analysis of Indiana Medicaid Recipient Satisfaction with Primary Care Physicians and Nurse Practitioners. (2015). PI: Maxey, H.L. Submitted to the Robert Wood Johnson Foundation.
Role: Researcher

SERVICE & COMMITTEE MEMBERSHIP:
University
Indiana University- Department of Family Medicine
Faculty Development Committee 2016-Present
Indiana University – Bloomington
Cheer Coach 2016-Present
Indiana University Purdue University Indianapolis
Cheer Coach 2012-Present
Graduate & Professional Student Government
Treasurer 2014-Present
MHA Student Association
Philanthropy Chair 2012-2013
Public Health Corps

Volunteer 2012-2013
Indiana University Kenya Partnership Gala Planning Committee
Committee Member 2012-2012

Service to the Profession
Multi-state Military Collaborative for Military Credit
Advisory Committee Member 2014-Present
National Health Service Corps
Ambassador 2013-Present
Indiana National Health Service Corps Project 2013
Advisory Committee Member 2012-Present
Indiana Prescription Drug Abuse & Prevention Task Force
Member 2014-Present
Naloxone Workgroup, Prescription Drug Abuse & Prevention Task Force
Member 2014-Present
Indiana Housing and Community Development Authority: Aging in Place
Policy Evaluation 2012-2013
National Health Service Corps Evaluation – Indiana
Project Coordinator 2012-2013
Healthcare Financial Management Association KPI Committee
Member 2011-2012
Cleveland Clinic Medical Mission (Leon, Nicaragua)
Volunteer 2010-2010

Service to the Community
Volunteer Tutor for Monroe County School Corporation 2008-2009

Ad hoc peer reviewer
Journal for the Healthcare for the Poor and Underserved
Journal of the American Pharmacists Association

PEER-REVIEWED PUBLICATIONS:

Maxey, H. L., Norwood, C. W., & Liu, Z. (2016). State policy environment and the dental safety net: a case study of professional practice environments' effect on dental service availability in Federally Qualified Health Centers. J Public Health Dent, 76(4), 295-302. doi:10.1111/jphd.12155

Neal, C. A., Wright, E. R., & Norwood, C. W. (2016). A qualitative analysis of prescribers' and dispensers' views on improving prescription drug monitoring programs. Research in Social & Administrative Pharmacy. doi:10.1016/j.sapharm.2016.12.002

Norwood, C. W., Biviji-Sharma, R., Knotts, A., Omenka, I., Stone, C., & Purviance, D. (2015). Fighting Prescription Drug Abuse Through State Policy: The Role of Nursing in Successful Implementation. J Addict Nurs, 26(4), 203-207. doi:10.1097/JAN.0000000000000097

Norwood, C. W., Maxey, H. L., Randolph, C., Gano, L., & Kochhar, K. (2016). Administrative Challenges to the Integration of Oral Health With Primary Care: A SWOT Analysis of Health Care Executives at Federally Qualified Health Centers. J Ambul Care Manage. doi:10.1097/JAC.0000000000000151

Norwood, C. W., & Wright, E. R. (2016). Integration of prescription drug monitoring programs (PDMP) in pharmacy practice: Improving clinical decision-making and supporting a pharmacist's professional judgment. Res Social Adm Pharm, 12(2), 257-266. doi:10.1016/j.sapharm.2015.05.008

Norwood, C. W., & Wright, E. R. (2016). Promoting consistent use of prescription drug monitoring programs (PDMP) in outpatient pharmacies: Removing administrative barriers and increasing awareness of Rx drug abuse. Res Social Adm Pharm, 12(3), 509-514. doi:10.1016/j.sapharm.2015.07.008

CONFERENCE PRECEEDINGS, ABTRACTS, AND PRESENTATIONS:

Maxey, H. L., Vaughn, S., Randolph, C., & Norwood, C. W. (2017). A Pathway to Diversifying the Nursing Workforce: Are Certified Nurses Aide the Answer Poster presented at the 13th Annual AAMC Health Workforce Research Conference, Arlington, VA.

Norwood, C. W. (2016). Using Prescription Drug Monitoring Programs (PDMPs) to Improve Clinical Decision-Making and Support Pharmacists' Professional Judgment. Poster presented at the 2016 Annual Research Meeting Academy Health, Boston, MA.

Norwood, C. W. (2016). Leveraging Existing Workforce Data in Policy Analysis: The Case of HIV in Scott County. Poster presented at the 2016 Annual Research Meeting Academy Health, Boston, MA.

Norwood, C. W., Hannah, H. L., & Randolph, C. (2016) Leveraging Existing Workforce Data in Policy Analysis: The Case of HIV in Scott County. Paper presented at the 12th Annual AAMC Health Workforce Research Conference, Chicago, IL.

Norwood, C. W. (2015). Integration of Prescription Drug Monitoring Programs (PDMP) in Pharmacy Practice: Improving Clinical Decision-Making and Supporting a Pharmacist's Professional Judgment. Paper presented at the The 6th Annual Rx Drug Abuse Symposium, Indianapolis, IN.

Norwood, C. W., & Wright, E. R. (2015). Prescription Drug Monitoring Programs (PDMPs) in pharmacy practice: A clinical resource to support pharmacists' professional judgment and fight prescription drug abuse. Paper presented at the 143rd APHA Annual Meeting and Exposition, Chicago, IL.

Norwood, C. W., Mullins, C., Biviji-Sharma, R., Church, A., Henderson, M., & Stone, C. (2015). Policy Advocacy Actions at the Organization, State and National Levels: Using Service Learning to Inform Policy at the State Level. Paper presented at the 143rd APHA Annual Meeting and Exposition, Chicago, IL.

Maxey, H. L., & Norwood, C. W. (2015). A Framework for Studying the Impact of State Policy on Access and Health: The case of dental hygiene and Federally Qualified Heath Centers (FQHC). Paper presented at the AcademyHealth 2015 Annual Research Meeting, Minneapolis, MN.

Norwood, C. W., Mullins, C., Biviji-Sharma, R., Church, A., Henderson, M., & Stone, C. (2015). Policy Advocacy Actions at the Organization, State and National Levels: Using Service Learning to Inform Policy at the State Level. Paper presented at the 143rd APHA Annual Meeting and Exposition, Chicago, IL.

Norwood, C. W. (2014). Indiana State Policy and the Prescription Drug Abuse Epidemic. Paper presented at the Manchester University Public Health Discussion Day, Manchester, IN.

BOOK CHAPTERS AND TECHNICAL REPORTS

Norwood, C. W., Sheff, Z., Walters, S., Zollinger, T., & Maxey, H. (2014). The Indiana National Health Service Corps Program: ARRA-funding's impact on recruitment, retention, and program capacity. Paper presented at the AcademyHealth Annual Research Meeting, San Diego, CA.

Arling, G., Nazir, A., Unroe, K., Bennett, M., LaMantia, M., Norwood, C. W., & Sachs, G. (2014). Avoiding Hospitalizations of Long-Stay Nursing Facility Residents: Preliminary Findings from the OPTIMISTIC Project. Paper presented at the AcademyHealth Annual Research Meeting, San Diego, CA.

Maxey, H. L., & Norwood, C. W. (2013). Indiana's Health Workforce: Description, Distribution, and Strategic Recommendation to Empowered Decision Making. Paper presented at the IRHA's 16th Annual Rural Health Conference, Indianapolis, IN.

Maxey, H. L., Norwood, C. W., & Osbourn, L. L. (2016). The U.S. Health System. In J. T. Finnell & B. E. Dixon (Eds.), Clinical Informatics Study Guide (pp. 23-46). Switzerland: Springer International Publishing. ISBN: 978-3-319-22752-8. Health Workforce Studies Program: Indiana University School of Medicine.

Norwood, C. W., Randolph, C., & Hannah, H. L. (2015). Policy Report: 2012 Substance Use Disorder Workforce. Health Workforce Studies Program: Indiana University School of Medicine.

Norwood, C. W., & Randolph, C. (2015). Policy Report: 2012 Indiana Pharmacist Workforce. Health Workforce Studies Program: Indiana University School of Medicine.

Norwood, C. W., Randolph, C. R., & Maxey, H. L. (2015). Policy Report: 2013 Indiana Nursing Workforce. Health Workforce Studies Program: Indiana University School of Medicine.

Norwood, C. W. (2015). A Student's Perspective on the Integration of Sociology in Public Health & Health Policy Research. The Publicizer (Spring), 5-6. Health Workforce Studies Program: Indiana University School of Medicine.

Maxey, H. L., Norwood, C. W. (2014). Policy Report: 2013 Indiana Mental Health Workforce: Health Workforce Studies Program: Indiana University School of Medicine.

Norwood, C. W., & Omenka, I. O. (2014). Indiana Housing and Community Development Authority: Policy Evaluation of Aging in Place (pp. 1-26). Indianapolis: IHCDA.

Maxey, H. L., Norwood, C. W., Walters, S. J., & Sheff, Z. (2013). 2013 Indiana National Health Service Corps Project: Recruitment, Retention & Evaluation: Indiana State Department of Health.

Maxey, H., Malcolm, A., Norwood, C., Sheff, Z., & Walters, S. (2012). Indiana Primary Health Care: Description, Distribution, Challenges, & Strategic Recommendation to Empowered Decision Making. Health Workforce Studies Program: Indiana University School of Medicine.

Norwood, C. W. (2011). Behavioral Assessments and Phenotyping of The 140 CAG Knock-In Mouse Model of Huntington's disease: Evaluation of Progression. Health Workforce Studies Program: Indiana University School of Medicine.

MEDIA, APPERANCES, & POPULAR PRESS:

Louden, K. (2015). Drug Monitoring Program Could Curb Prescription Drug Abuse. Medscape Medical News. Retrieved from http://www.medscape.com/viewarticle/854481

LEGISLATIVE TESTIMONY:

Senate Bill 406: Overdose Intervention Drugs. Senate Health and Provider Services Committee First Regular Session 119th General Assembly ed. Indianapolis, IN 2015.

Senate Bill 406: Overdose Intervention Drugs. House of Representatives Public Health Committee. First Regular Session 119th General Assembly ed. Indianapolis, IN 2015.